

Transportation Safety Board
of CanadaBureau de la sécurité des transports
du Canada**FAX**

TO / DESTINATAIRE		FROM / EXPÉDITEUR	
NAME / NOM Mr. Allan Yurman		NAME / NOM Mr. Denis Deroy	
FIRM / SOCIÉTÉ NTSB		TITLE / TITRE Technical Investigator	
LOCATION / ENDROIT Florida	FACSIMILE NO. / N° TÉLÉCOPIEUR [REDACTED]	TÉL. NO. / N° DE TÉL. [REDACTED]	FACSIMILE NO. / N° TÉLÉCOPIEUR [REDACTED]
DISTRIBUTION <input checked="" type="checkbox"/> ROUTINE ROUTINIÈRE <input type="checkbox"/> URGENT URGENTE		ORIGINAL TO BE SENT BY MAIL / ORIGINAL À ÊTRE ENVOYÉ PAR COURRIER <input type="checkbox"/> Yes Oui <input checked="" type="checkbox"/> No Non	
THIS MESSAGE IS INTENDED FOR THE USE OF THE ADDRESSEE ONLY. IF YOU HAVE RECEIVED THIS COMMUNICATION IN ERROR, PLEASE NOTIFY THE SENDER IMMEDIATELY. CE MESSAGE EST POUR L'USAGE DU DESTINATAIRE SEULEMENT. SI VOUS AVEZ REÇU CETTE COMMUNICATION PAR ERREUR, VEUILLEZ EN INFORMER L'EXPÉDITEUR IMMÉDIATEMENT.		NUMBER OF PAGES (including this cover) 9 NOMBRE DE PAGES (y compris ce formulaire)	
MESSAGE Good morning Mr. Yurman You will find a copy of the initial report on the tear-down of PT6A-20, s/n 20801 and 22008. The investigation team conclude that both engines were not producing power at impact (windmilling) this conclusion was also confirmed by Mr. Tom McCreary from Hartzell who also establish that damages on both propellers were not consistent with a full power engine. If you need more info's please call me Best regards, [REDACTED] Denis Deroy			

Canada



FACTUAL NOTES, ENGINE TEARDOWN INVESTIGATION IN SUPPORT OF ACCIDENT INVESTIGATION OF BEECHCRAFT B-90 REG. N338AS PERFORMED FOR THE NATIONAL TRANSPORTATION SAFETY BOARD.

1. INVESTIGATION PARTICIPANTS

The powerplant investigation was performed on 7-8 December 1999 at the Pratt & Whitney Canada Service Investigation Facilities at St. Hubert, Quebec, Canada. The following individuals participated in the investigation as representatives of their respective organisations:

Denis Deroy	Investigator Transportation Safety Board Canada
Robin Lau	Senior Engineer-Powerplants, Continuing Airworthiness Transport Canada Safety and Security
Philip Champion-Demers	Technical Inspector, Continuing Airworthiness Transport Canada Safety and Security
Harold Barrentine	Sr. Engineer, Air Safety Investigation Raytheon Aircraft Corporation
Tom McCreary	Manager, Field Investigations Hartzell Propeller Inc.
Thomas A. Berthe	Service Investigation Pratt & Whitney Canada

2. LEFT HAND ENGINE HISTORY

PT6A-20 S/N 20801

Hours Since New: 24,874

Cycles Since New: 59,927

Hours Since Overhaul: 2926

Cycles Since Overhaul: 4235

The above times and cycles are as of the last hot section inspection for the engine, completed 29 June 1999 by Banyon Air Service, Ft. Lauderdale, FL, under W/O 80/30763. The hot section inspection included installation of a new compressor turbine disc, and replacement of the compressor turbine blades, vane segments, and shrouds with FAA-PMA units.

3. LEFT HAND ENGINE EXAMINATION

All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

3.1 External Condition

The engine displayed moderate impact damage and light post impact fire damage. The engine was received with the airframe related propeller hub, exhaust stubs, starter generator, and pressurisation supercharger attached. The propeller was removed for inspection by the Hartzell Representative. Following external inspection, the engine related controls and accessories were removed for separate investigation. Please refer to section 3.3 of this report for details of this activity.

3.1.1 External Cases

Reduction Gearbox: The housing and propeller shaft were intact. The propeller shaft was displaced slightly aft. The propeller governor, overspeed governor, and power turbine governor were in place and intact. The airframe torque measuring and secondary low pitch stop mechanism appeared in place and intact.

Exhaust Duct: Displayed compressional deformation. The reduction gearbox was separated from the forward flange around the right hand circumference, and displaced approximately 20 degrees to the left in relation to the engine centreline.

Gas Generator Case: Displayed light compressional deformation. The fuel manifold, T5 harness, and bleed valve were in place and intact.

Accessory Gearbox: The housing was intact. The oil to fuel heater was fractured from it's mounting boss. The high pressure fuel pump and fuel control unit were in place and intact, with fire and heat damage. The T2 compensator was in place and intact.

3.1.2 Power Control and Reversing Linkage

The linkage was continuous from the beta feed back mechanism to the controls cambox and fuel control input linkage.

3.1.3 Pneumatic Lines

Compressor Discharge Air (P3): The P3 line was continuous, with fire and heat damage, from the gas generator case fitting to the fuel control unit fitting.

Power Turbine Control (Py): Continuous from the fuel control unit fitting to the power turbine overspeed governor fitting.

3.1.4 Chip Detectors and Filters

Reduction Gearbox Chip Detector: Clean.

Oil Filter: Clean.

3.2 Disassembly Observations

3.2.1 Compressor Section

Compressor 1st, 2nd, and 3rd Stage Discs and Blades: Displayed no distress.

Compressor 1st, 2nd, and 3rd Stage Stators and Shrouds: Displayed no distress.

Compressor 1st, 2nd, and 3rd Stage Spacers: Displayed no distress.

Centrifugal Impeller: The impeller vane tips displayed light circumferential rubbing due to contact with the impeller shroud.

Centrifugal Impeller Shroud: The shroud face displayed light circumferential rubbing due to contact with the impeller.

Front Stub Shaft: Intact.

No. 1 Bearing and Airseals: Displayed no distress.

No. 2 Bearing and Airseals: Displayed no distress.

3.2.2 Combustion Section

Combustion Chamber Liner: Displayed no distress.

Large Exit Duct: Displayed no distress. The flame pattern indications appeared normal.

Small Exit Duct: Displayed no distress.

3.2.3 Turbine Section

Compressor Turbine Guide Vane Ring: The vane airfoils displayed no indications of distress.

Compressor Turbine Shroud: Displayed light circumferential scoring due to radial contact with the compressor turbine blade tips.

Compressor Turbine: The blade tips displayed light circumferential rubbing due to radial contact with the compressor turbine shroud. The downstream side disc face displayed light circumferential scoring due to axial contact with the interstage baffle.

ITT Probes, Busbar, and Harness: Displayed no distress.

Power Turbine Housing: Displayed no distress.

Power Turbine Guide Vane Ring and Interstage Baffle: The vane airfoils displayed no indications of operational distress. The inner drum downstream side and interstage baffle outer rim displayed light circumferential rubbing due to axial contact with the compressor turbine disc. The baffle inner cup was circumferentially scored and radially deformed due to contact with the disc hub spigot. The inner drum downstream side was fractured and deformed from the approximate 2:00 to 4:00 positions due to axial contact with the power turbine. The downstream side outer drum was circumferentially scored due to axial contact with the power turbine blade tip shrouds. The inner drum and baffle outer rim displayed light circumferential rubbing, with light static imprint marks around the lower circumference, due to axial contact with the power turbine disc. The baffle inner cup was severely deformed due to contact with the power turbine hub spigot.

Power Turbine Shroud: Displayed circumferential rubbing due to radial contact with the power turbine blade tips.

Power Turbine: Observed in-situ. The vane airfoils across approximately $\frac{1}{2}$ of the disc diameter were deformed into the direction of rotation and fractured at approximately $\frac{2}{3}$ span, due to axial and radial contact with the power turbine shroud and guide vane ring. The vane tips were circumferentially rubbed due to radial contact with the power turbine shroud. The power turbine disc displayed no distress.

Power Turbine Shaft and Shaft Housing: Not accessed.

3.2.4 Reduction Gearbox

The reduction gearbox housing was separated at flange "A" for access. The 1st and 2nd stage gearing displayed no distress.

3.2.5 Accessory Gearbox

The accessory gearing rotated smoothly through the input shaft. The accessory gearbox was not disassembled.

3.3 Controls and Accessories Evaluation

To be forwarded upon completion.

4. RIGHT HAND ENGINE HISTORY

PT6A-20 S/N 22008

Hours Since New: 32,447

Cycles Since New: 54,082

Hours Since Overhaul: 3113.9

Cycles Since Overhaul: 4358

The above times and cycles are as of the last hot section inspection for the engine, completed 29 June 1999 by Banyan Air Service, Ft. Lauderdale, FL, under W/O 80/30763. The hot section inspection included installation of a serviceable compressor turbine disc, and replacement of the compressor turbine blades, vane segments, and shrouds, with FAA-PMA units.

5. RIGHT HAND ENGINE EXAMINATION

All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

5.1 External Condition

The engine displayed moderate impact damage and light post impact fire damage. The engine was received with the airframe related propeller hub, exhaust stubs, and starter generator attached. The propeller was removed for inspection by the Hartzell Representative. Following external inspection, the engine related controls and accessories were removed for separate investigation. Please refer to section 5.3 of this report for details of this activity.

5.1.1 External Cases

Reduction Gearbox: The housing and propeller shaft appeared intact. The propeller shaft was displaced slightly aft. The propeller governor and overspeed governor were intact. The power turbine overspeed governor top cover was impact fractured. The airframe torque measuring system and secondary low pitch stop mechanism were in place, with impact damage.

Exhaust Duct: Displayed compressional damage around the lower circumference. The reduction gearbox was separated from the forward flange around the upper circumference, and displaced approximately 15 degrees downward in relation to the engine centreline.

Gas Generator Case: Displayed light compressional deformation. The fuel manifold, T5 harness, and bleed valve were in place and intact.

Accessory Gearbox: The housing was intact. The oil to fuel heater was fractured from it's mounting boss. The high pressure fuel pump and the fuel control unit were in place, with impact damage to the fuel control unit housing. The fuel control unit fuel output fitting was impact fractured. The T2 compensator was in place and intact.

5.1.2 Power Control and Reversing Linkage

The linkage was continuous, with impact deformation, from the beta feed back mechanism to the controls cambox. The fuel control unit input linkage was fractured and deformed.

5.1.3 Pneumatic Lines

Compressor Discharge Air (P3): Continuous from the gas generator case fitting to the fuel control unit fitting.

Power Turbine Control (Py): Continuous from the fuel control unit fitting to the power turbine overspeed governor fitting.

5.1.4 Chip Detectors and Filters

Reduction Gearbox Chip Detector: Clean.

Oil Filter: Clean.

5.2 Disassembly Observations

5.2.1 Compressor Section

Compressor 1st, 2nd, and 3rd Stage Discs and Blades: Displayed no distress.

Compressor 1st, 2nd, and 3rd Stage Stators and Shrouds: Displayed no distress.

Compressor 1st, 2nd, and 3rd Stage Spacers: Displayed no distress.

Centrifugal Impeller: The impeller vane tips displayed light circumferential rubbing due to contact with the impeller shroud.

Centrifugal Impeller Shroud: The shroud face displayed light circumferential rubbing due to contact with the impeller.

Front Stub Shaft: Intact.

No. 1 Bearing and Airseals: Displayed no distress.

No. 2 Bearing and Airseals: Displayed no distress.

5.2.2 Combustion Section

Combustion Chamber Liner: Displayed no distress.

Large Exit Duct: Displayed no distress. The flame pattern indications appeared normal.

Small Exit Duct: Displayed no distress.

5.2.3 Turbine Section

Compressor Turbine Guide Vane Ring: The vane airfoils displayed no indications of operational distress. Two of the airfoil leading edges displayed light burning and erosion.

Compressor Turbine Shroud: Displayed light circumferential scoring due to radial contact with the compressor turbine blade tips.

Compressor Turbine: The blade tips displayed light circumferential rubbing due to radial contact with the compressor turbine shroud. The downstream side disc face displayed light circumferential scoring due to axial contact with the interstage baffle.

ITT Probes, Busbar, and Harness: Displayed no distress.

Power Turbine Housing: Displayed no distress.

Power Turbine Guide Vane Ring and Interstage Baffle: The vane airfoils displayed no indications of operational distress. The inner drum downstream side and interstage baffle outer rim were lightly circumferentially rubbed due to axial contact with the compressor turbine disc. The baffle inner cup was circumferentially scored and radially deformed due to contact with the disc hub spigot. The downstream side outer drum displayed light circumferential scoring, with concurrent static imprint marks, due to axial contact with the power turbine blade tip shrouds. The inner drum and baffle outer rim displayed light circumferential rubbing, with heavy static imprint marks and tearing of the baffle outer rim around the upper circumference, due to axial contact with the power turbine disc. The baffle inner cup was deformed due to contact with the power turbine hub spigot.

Power Turbine Shroud: Displayed circumferential rubbing due to radial contact with the power turbine blade tips.

Power Turbine: The vane airfoils across approximately $\frac{1}{2}$ of the disc diameter were displaced forward in their fir tree slots, and deformed into the direction of rotation and forward, with some airfoils partially fractured at approximately $\frac{2}{3}$ span, due to axial and radial contact with the power turbine shroud and guide vane ring. The vane tips were circumferentially rubbed due to radial contact with the power turbine shroud. The power turbine disc displayed no distress.

Power Turbine Shaft and Shaft Housing: Not disassembled. The No. 3 bearing airseal rotor was removed with the power turbine disc, and displayed circumferential rubbing and scoring due to radial contact with the stator knife edges.

5.2.4 Reduction Gearbox

The reduction gearbox housing was separated at flange "A" for access. The 1st and 2nd stage gearing displayed no distress.

5.2.5 Accessory Gearbox

The accessory gearing rotated smoothly through the input shaft. The accessory gearbox was not disassembled.


5.3 Controls and Accessories Evaluation

To be forwarded upon completion.

6. CLOSING:

These factual notes are based upon observations made on 7-8 December 1999, and may be altered or corrected on the basis of further information.

PRATT & WHITNEY CANADA


Thomas A. Berthe
Service Investigation
8 December 1999

**6. PHOTO LISTING****Photo No. Description****Left hand engine S/N 20801**

1. Engine left hand forward view.
2. Engine right hand aft view.
3. Accessory gearbox and aft gas generator case, right hand aft view.
4. Reduction gearbox chip detector.
5. Oil filter.
6. Compressor 1st, 2nd, and 3rd stage discs.
7. Compressor 1st, 2nd, and 3rd stage stators.
8. Centrifugal impeller and shroud.
9. Impeller shroud, detail.
10. Nos. 1 and 2 bearings.
11. Combustion chamber liner.
12. Large exit duct.
13. Small exit duct and compressor turbine guide vane ring, upstream side.
14. Compressor turbine guide vane ring, downstream side.
15. Compressor turbine guide vane ring and compressor turbine shroud, detail.
16. Compressor turbine, upstream side.
17. Compressor turbine downstream side.
18. Compressor turbine downstream side, detail.
19. Power turbine housing.



- 20. Power turbine guide vane ring and interstage baffle, upstream side.
- 21. Power turbine guide vane ring and interstage baffle upstream side, detail.
- 22. Power turbine guide vane ring and interstage baffle, downstream side.
- 23. Power turbine guide vane ring and interstage baffle downstream side, detail.
- 24. Power turbine upstream side, in-situ.
- 25. Power turbine shroud and blade tips, in-situ, detail.
- 26. Power turbine upstream side, detail.
- 27. Reduction gearbox 1st stage gearing.
- 28. Reduction gearbox 2nd stage gearing.

Right hand engine S/N 22008

- 29. Engine left hand forward view.
- 30. Engine right hand aft view.
- 31. Accessory gearbox and aft gas generator case, right hand aft view.
- 32. Reduction gearbox chip detector.
- 33. Oil filter.
- 34. Compressor 1st, 2nd, and 3rd stage discs.
- 35. Compressor 1st, 2nd, and 3rd stage stators.
- 36. Centrifugal impeller and shroud.
- 37. Impeller shroud, detail.
- 38. Nos. 1 and 2 bearings.
- 39. Combustion chamber liner.



- 40. Large exit duct.
- 41. Small exit duct and compressor turbine guide vane ring, upstream side.
- 42. Compressor turbine guide vane ring, downstream side.
- 43. Compressor turbine guide vane ring and compressor turbine shroud, detail.
- 44. Compressor turbine, upstream side.
- 45. Compressor turbine downstream side.
- 46. Compressor turbine downstream side, detail.
- 47. Power turbine housing.
- 48. Power turbine guide vane ring and interstage baffle, upstream side.
- 49. Power turbine guide vane ring and interstage baffle upstream side, detail.
- 50. Power turbine guide vane ring and interstage baffle, downstream side.
- 51. Power turbine guide vane ring and interstage baffle downstream side, detail.
- 52. Power turbine shroud, detail.
- 53. Power turbine upstream side.
- 54. Power turbine upstream side, detail.
- 55. Reduction gearbox 1st stage gearing.
- 56. Reduction gearbox 2nd stage gearing.

Accident / Incident Report

P&WC 8114 (11-98)



Pratt & Whitney Canada
A United Technologies Company

Report No.: TL-1503



Photo No. 1
Engine left hand forward view.

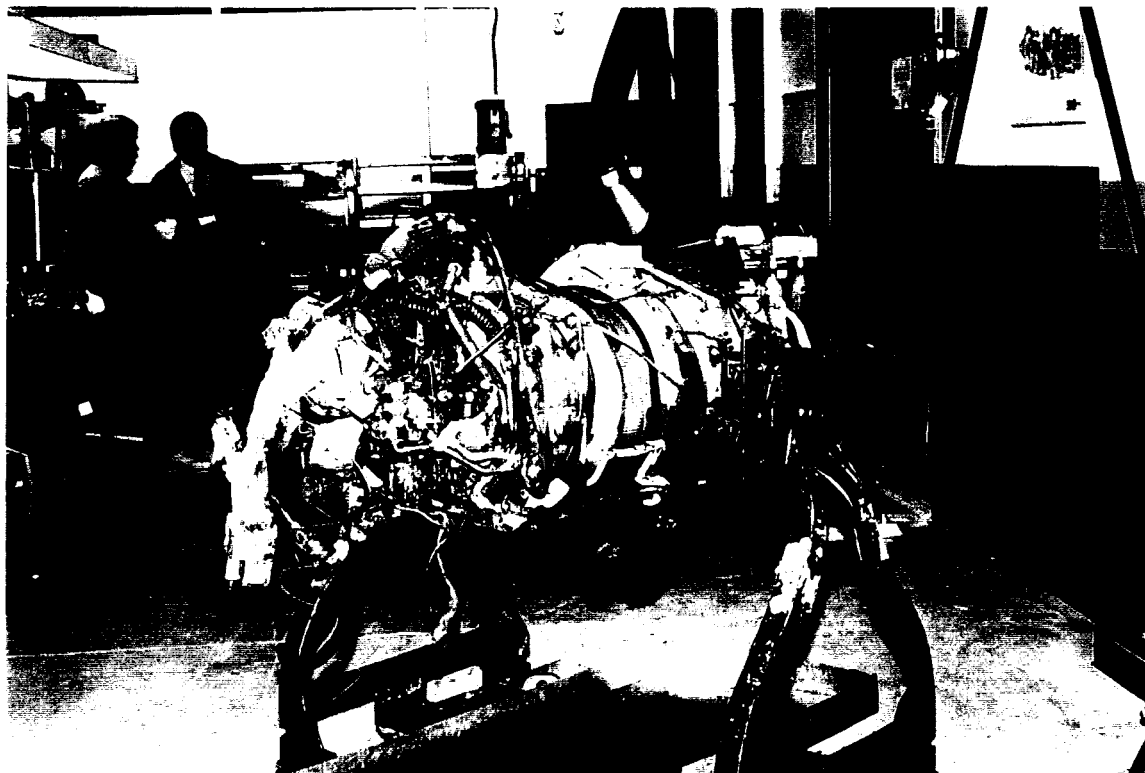


Photo No. 2
Engine right hand aft view.

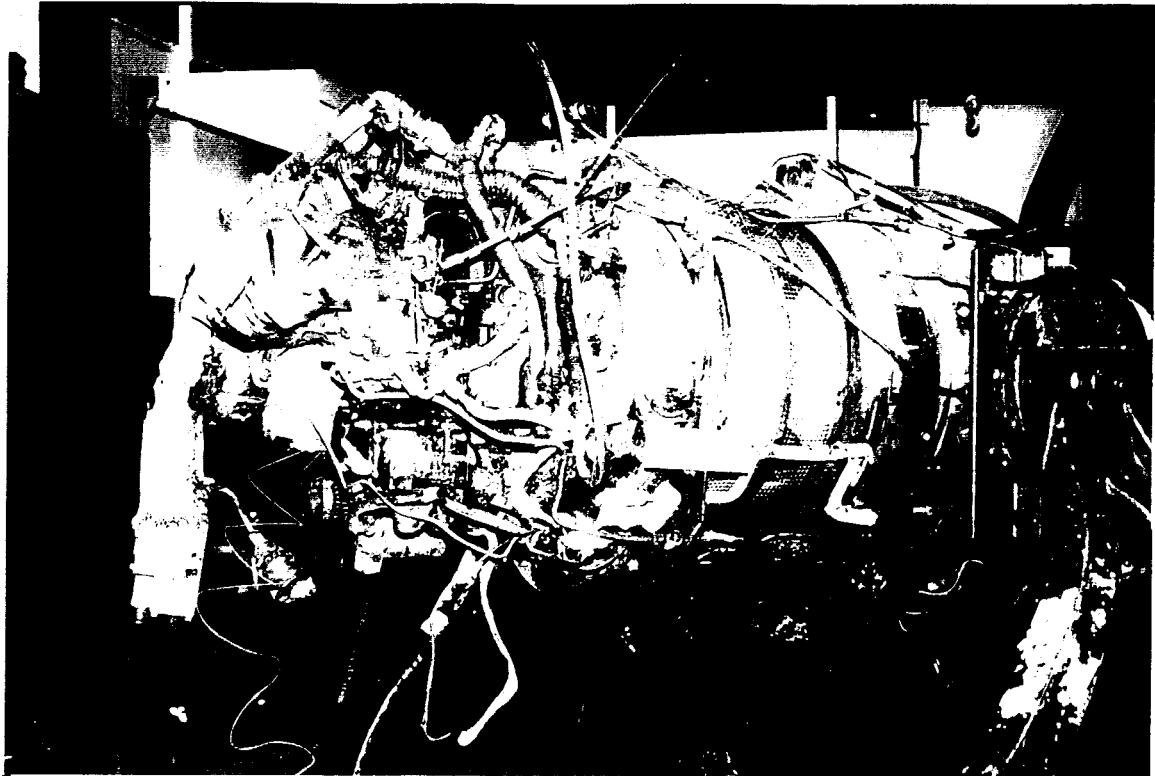


Photo No. 3

Accessory gearbox and aft gas generator case, right hand aft view.



Photo No. 4

Reduction gearbox chip detector.

Accident / Incident Report

P&WC 8114 (11-98)



Pratt & Whitney Canada
A United Technologies Company

Report No.: TL-1503

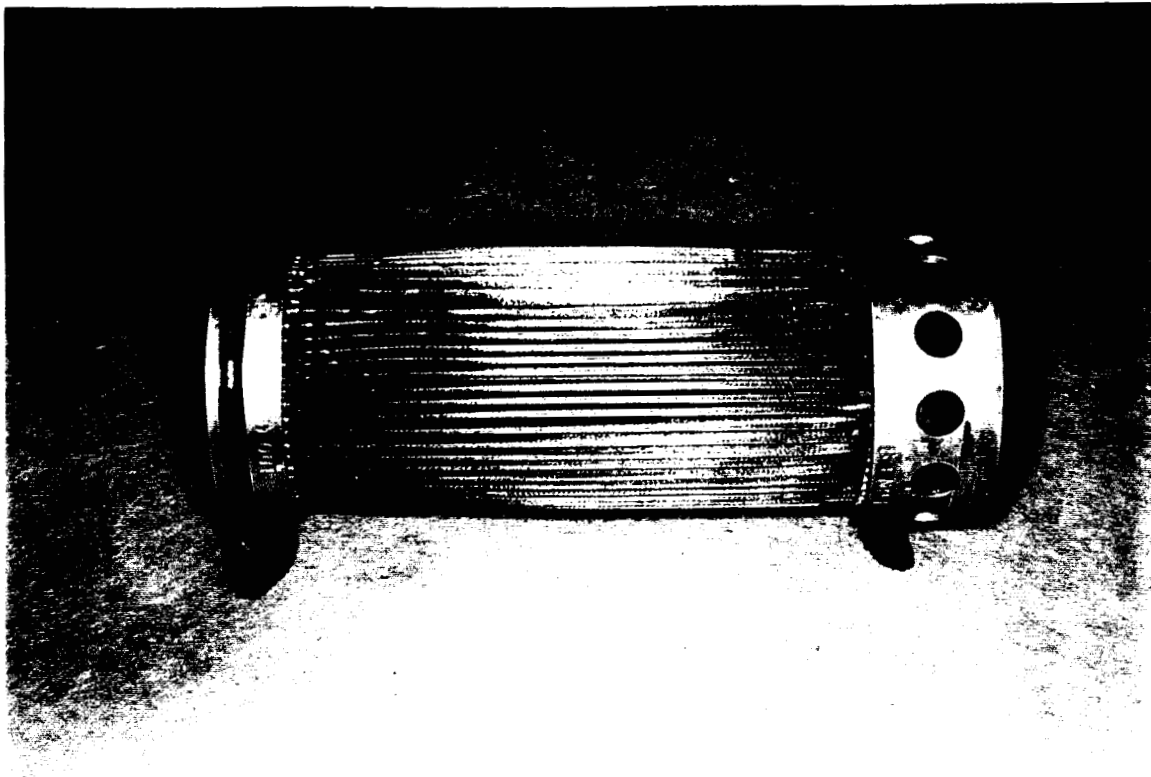


Photo No. 5
Oil filter.

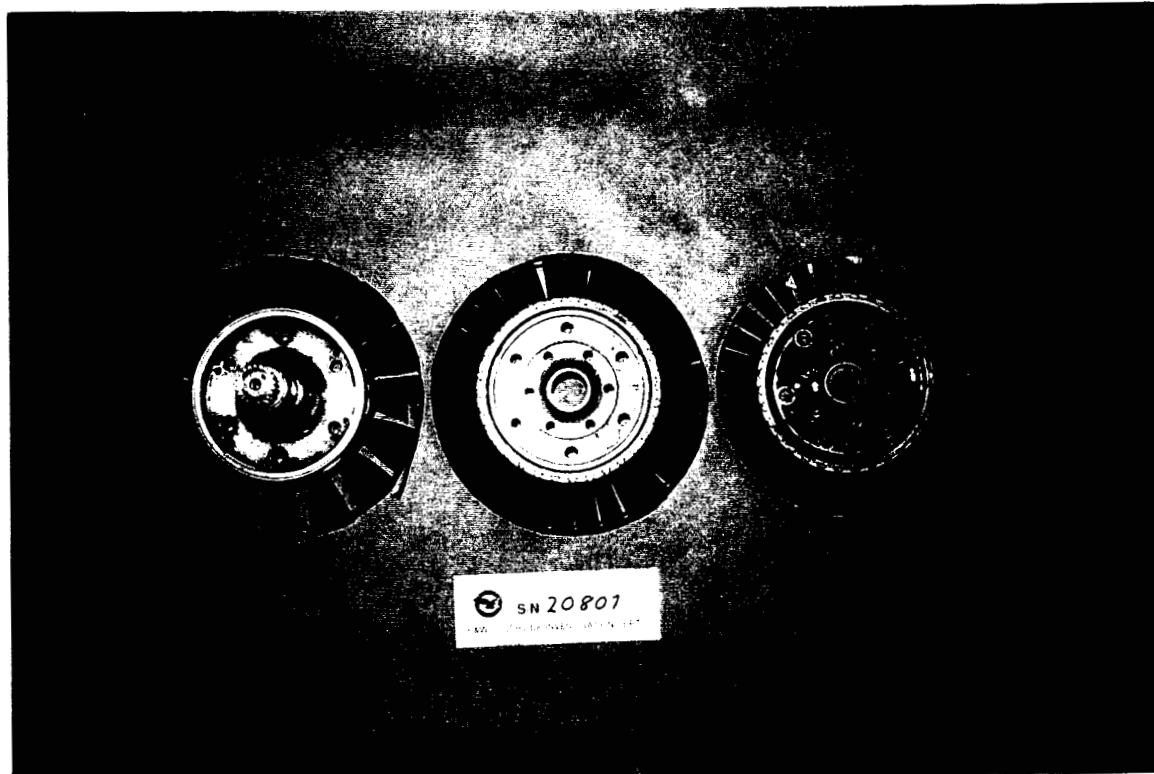


Photo No. 6
Compressor 1st, 2nd, and 3rd stage discs.

Service Investigation
Accident / Incident Report

P&WC 8114 (11-98)

Report No.: TL-1503

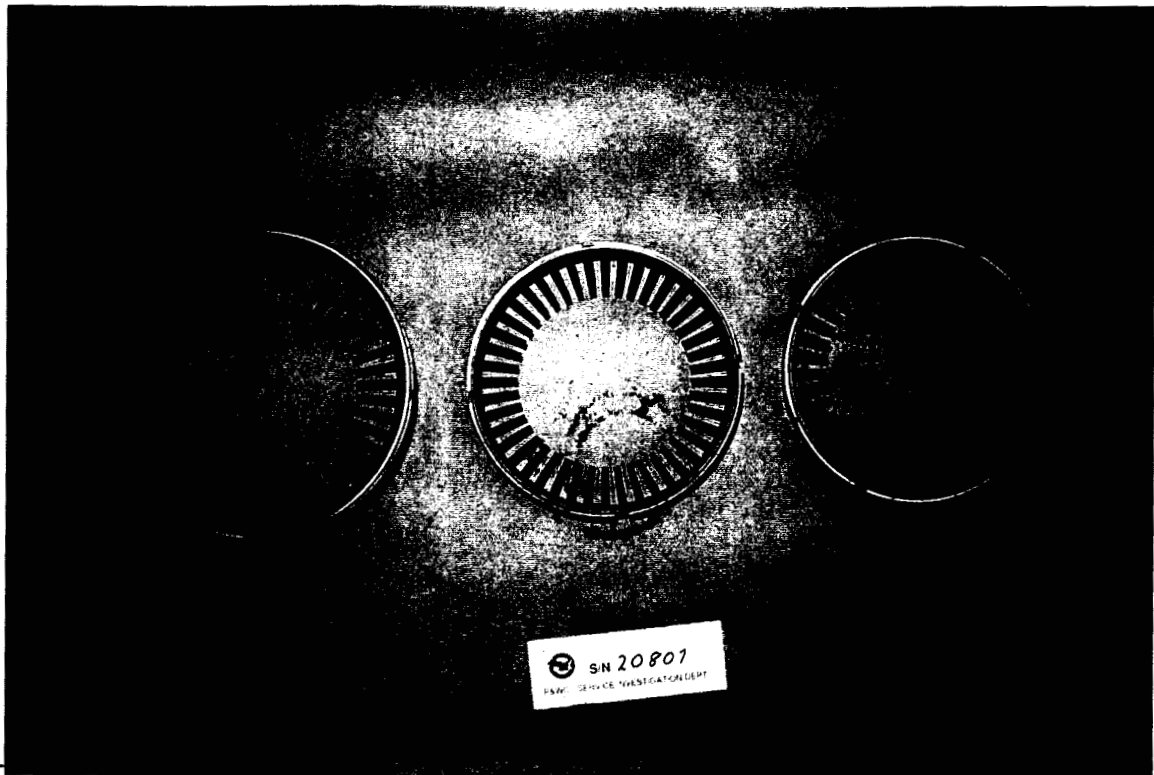


Photo No. 7
Compressor 1st, 2nd, and 3rd stage stators.

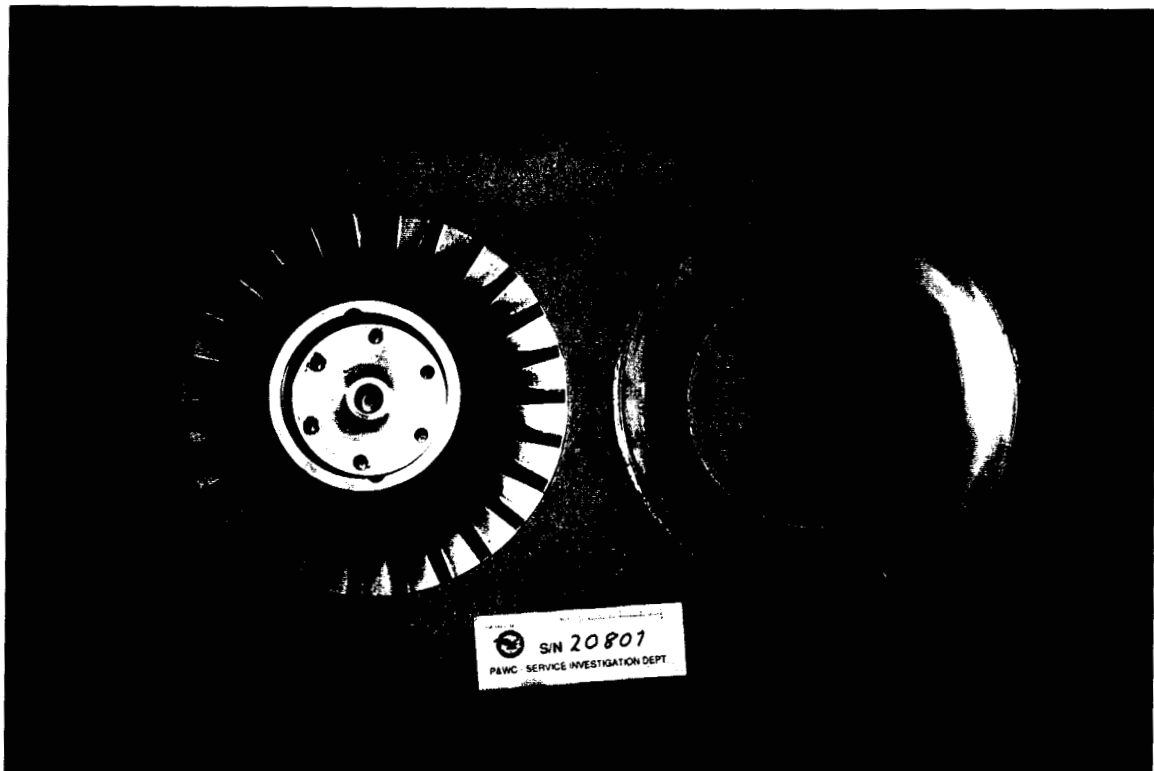


Photo No. 8
Centrifugal impeller and shroud.



Photo No. 9
Impeller shroud, detail.



Photo No. 10
Nos. 1 and 2 bearings.

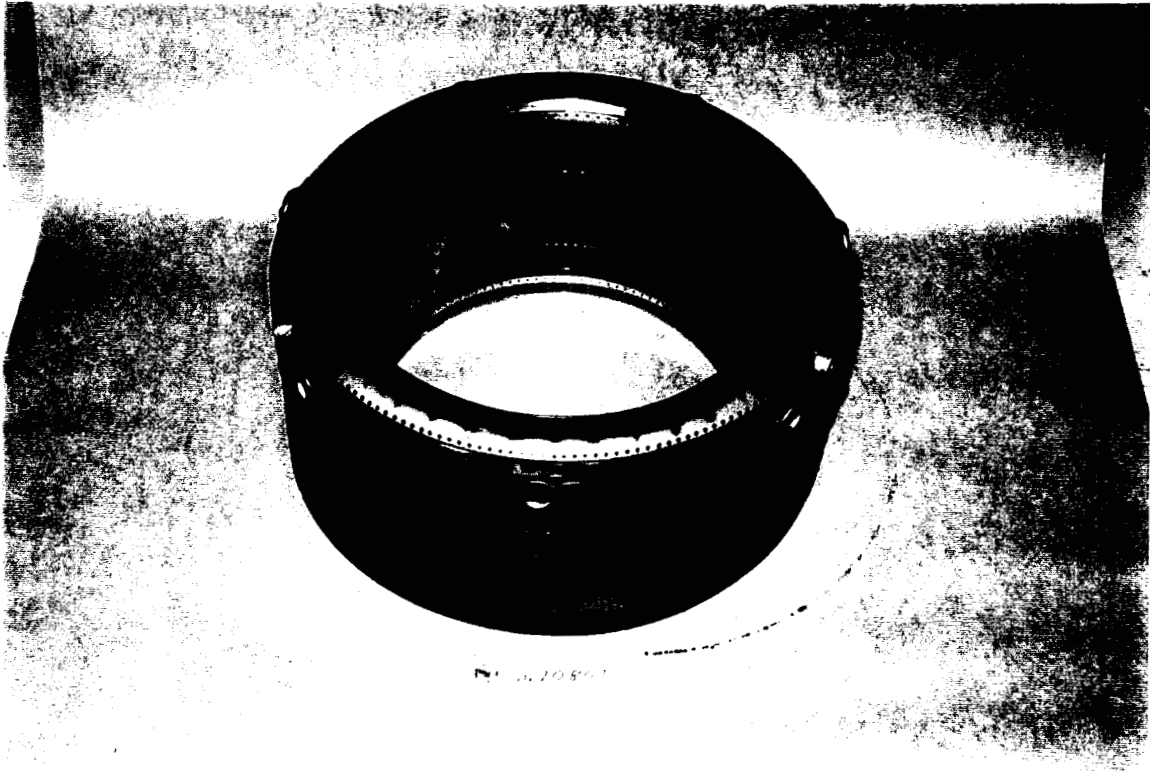


Photo No. 11
Combustion chamber liner.

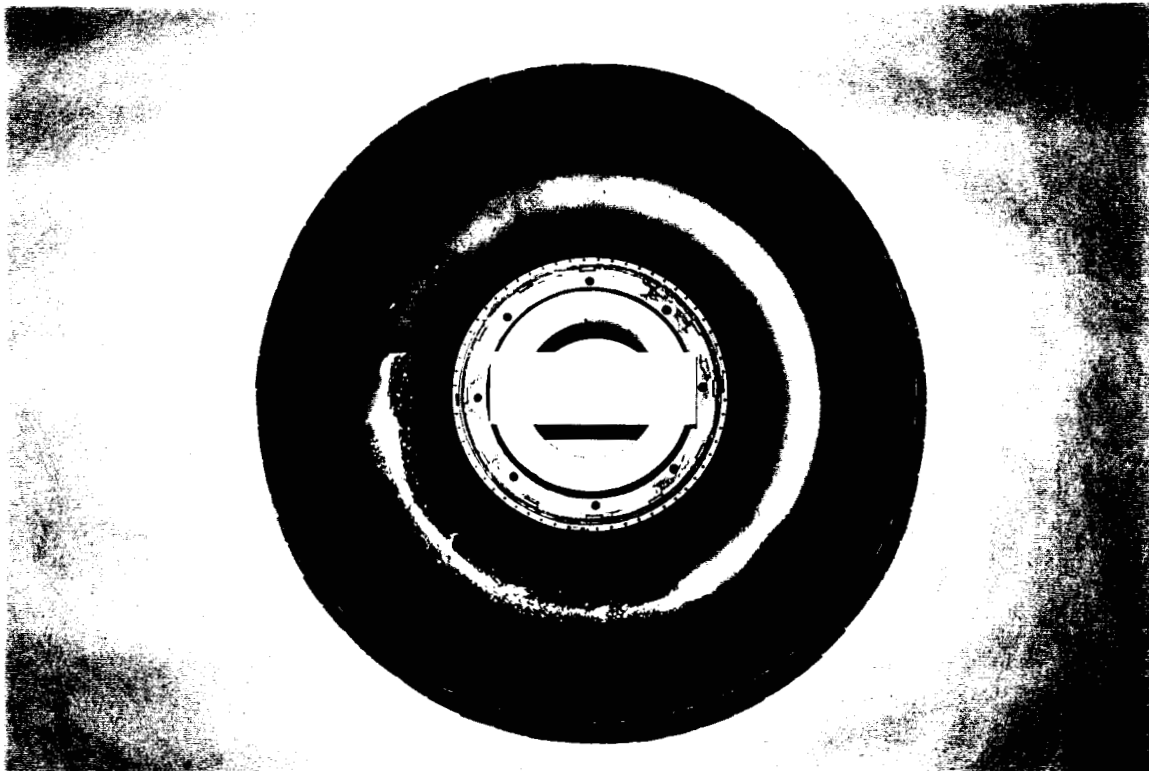


Photo No. 12
Large exit duct.



Photo No. 13
Small exit duct and compressor turbine guide vane ring, upstream side.

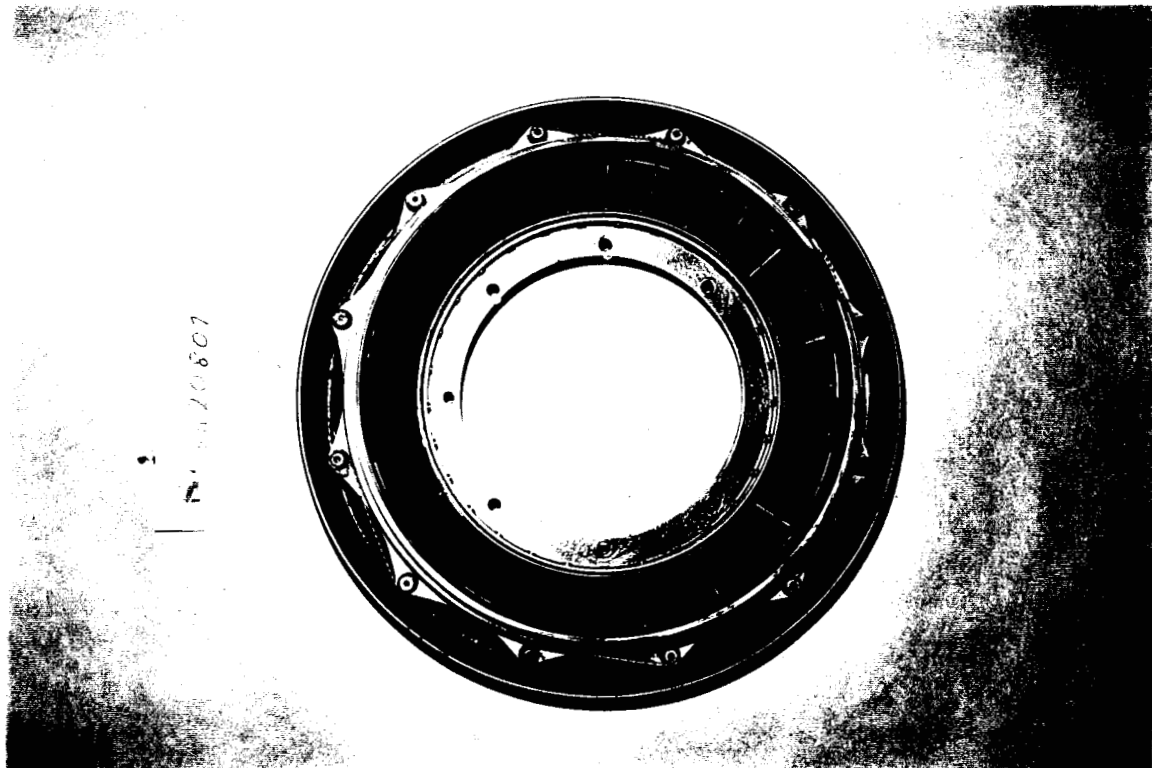


Photo No. 14
Compressor turbine guide vane ring, downstream side.



Photo No. 15

Compressor turbine guide vane ring and compressor turbine shroud, detail.



Photo No. 16

Compressor turbine, upstream side.

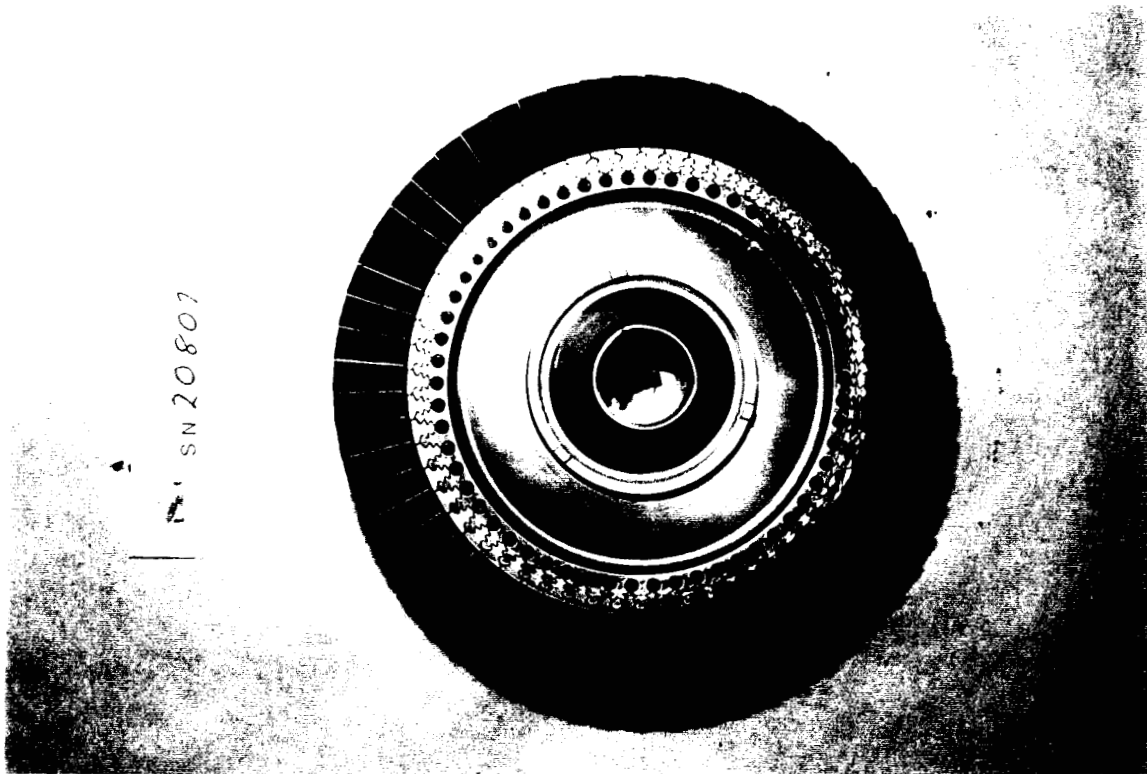


Photo No. 17
Compressor turbine downstream side.

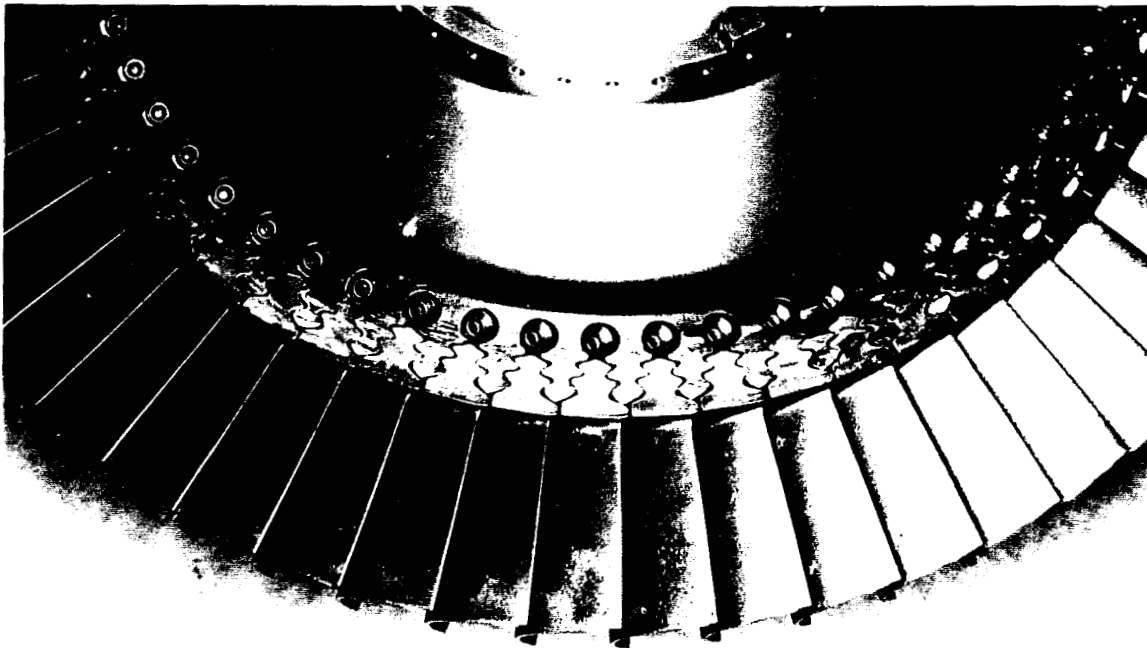


Photo No. 18
Compressor turbine downstream side, detail.

Accident / Incident Report

P&WC 8114 (11-98)

Report No.: TL-1503

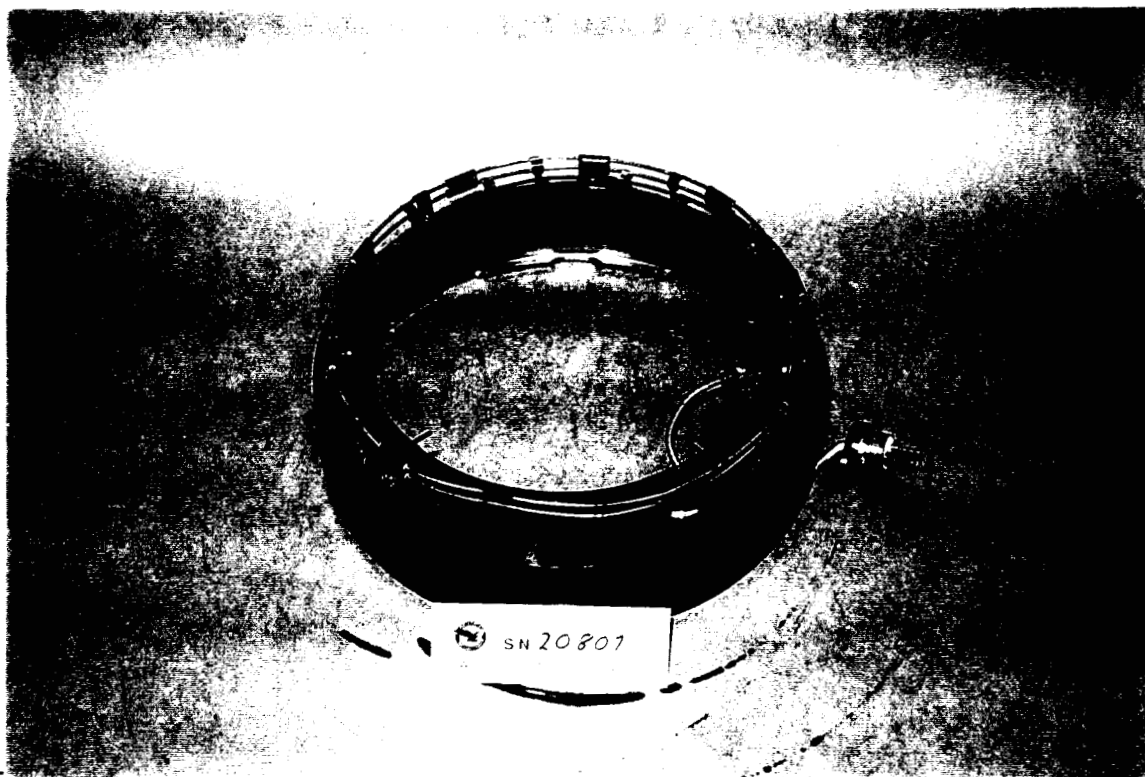


Photo No. 19
Power turbine housing.

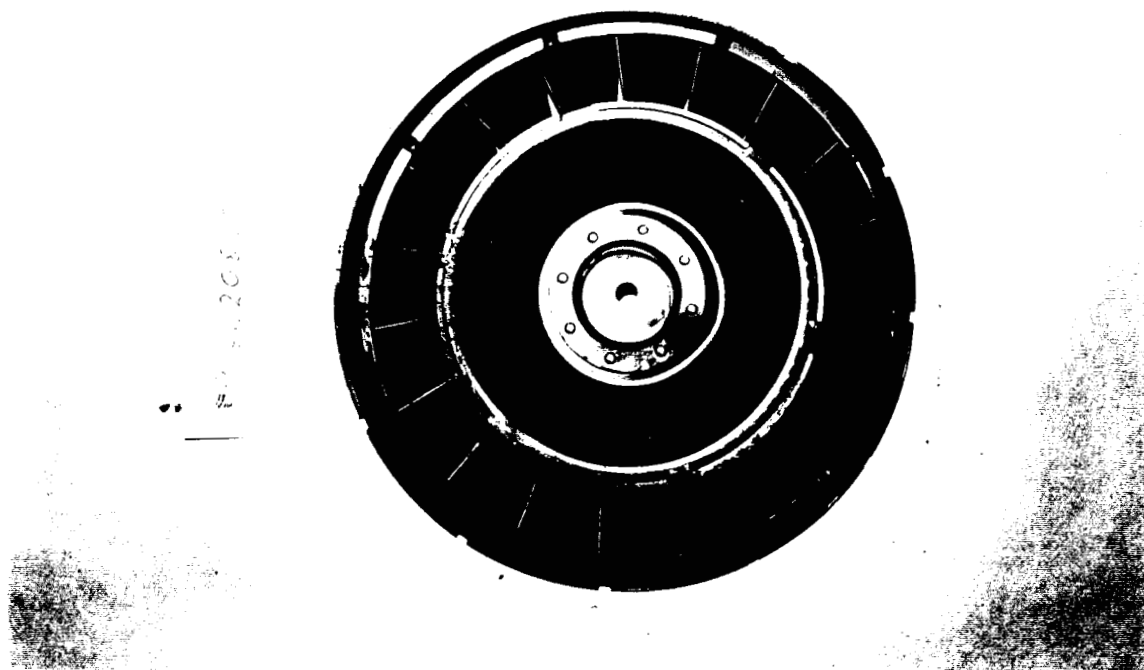


Photo No. 20
Power turbine guide vane ring and interstage baffle, upstream side.



Photo No. 21

Power turbine guide vane ring and interstage baffle upstream side, detail.

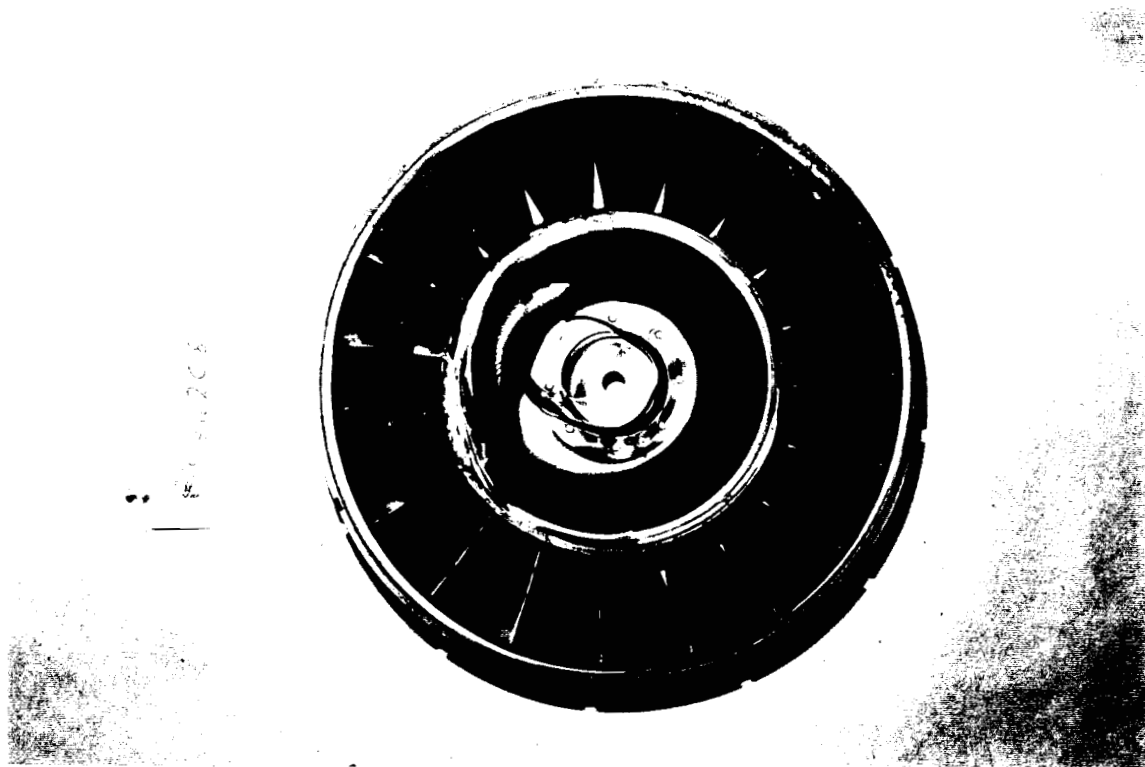


Photo No. 22

Power turbine guide vane ring and interstage baffle, downstream side.



Photo No. 23

Power turbine guide vane ring and interstage baffle downstream side, detail.

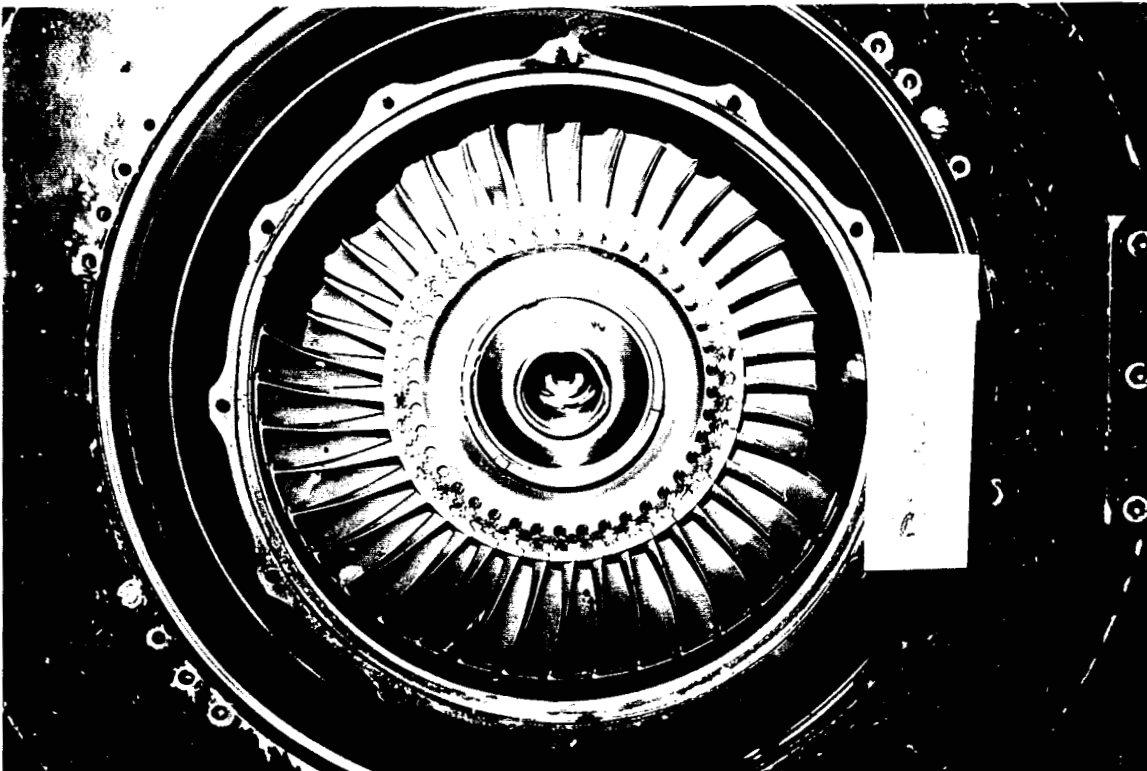


Photo No. 24

Power turbine upstream side, in-situ.



Photo No. 25

Power turbine shroud and blade tips, in-situ, detail.



Photo No. 26

Power turbine upstream side, detail.

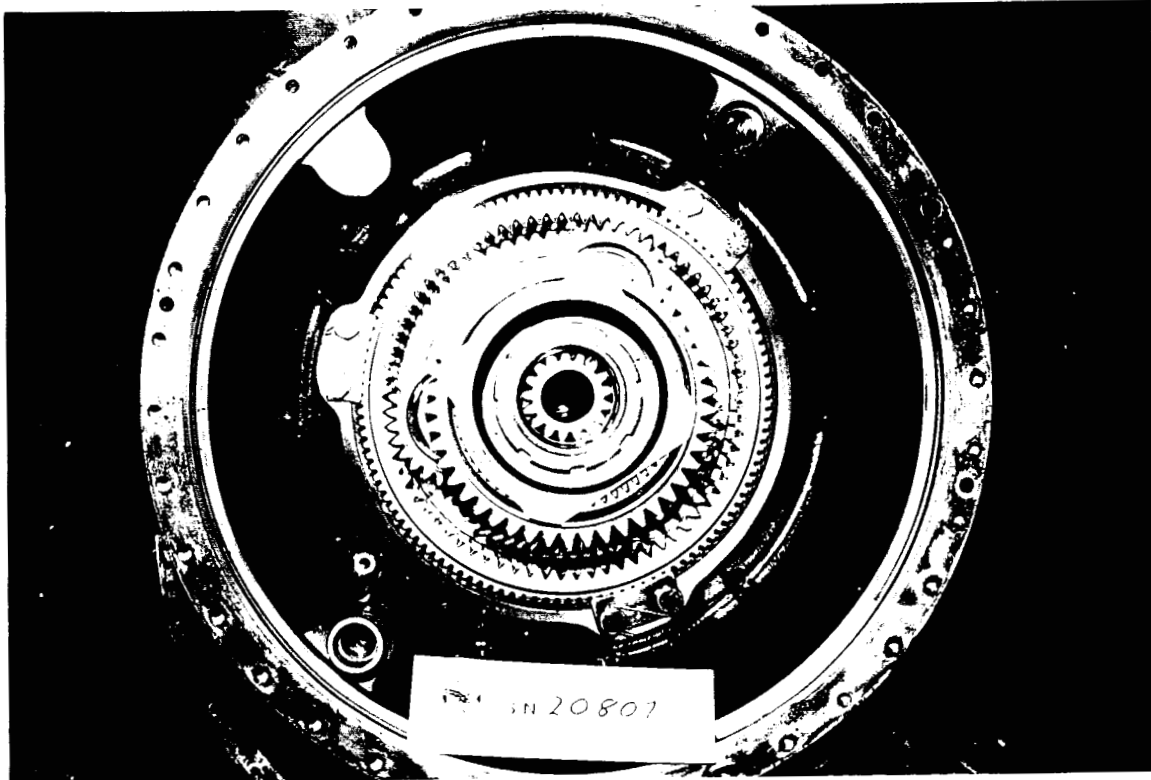


Photo No. 27
Reduction gearbox 1st stage gearing.

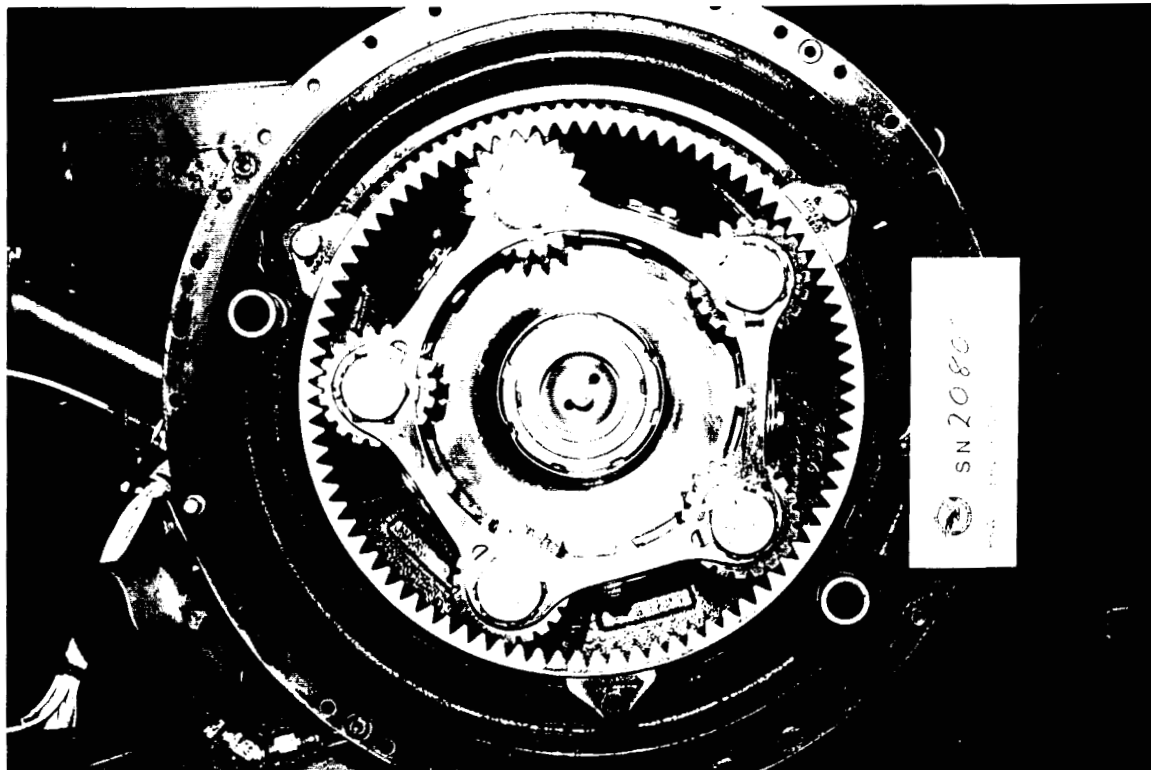


Photo No. 28
Reduction gearbox 2nd stage gearing.

Accident / Incident Report

P&WC 8114 (11-98)



Pratt & Whitney Canada
A United Technologies Company

Report No.: TL-1503

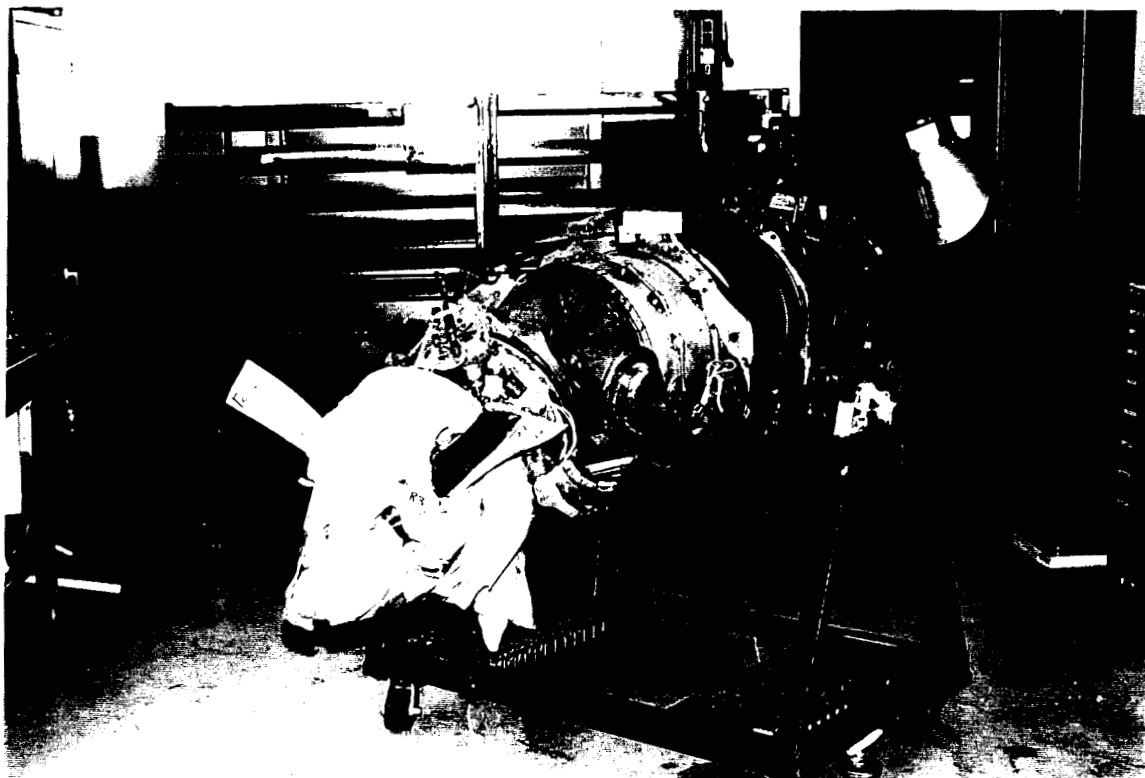


Photo No. 29
Engine left hand forward view.

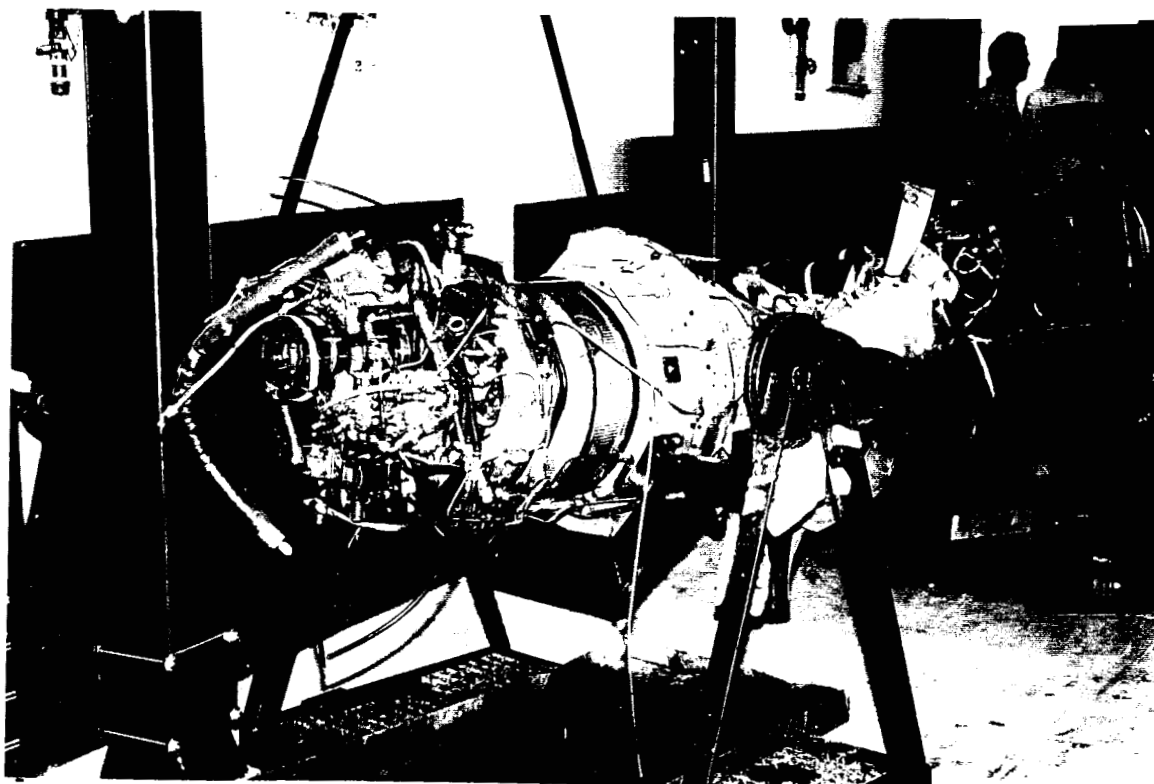


Photo No. 30
Engine right hand aft view.

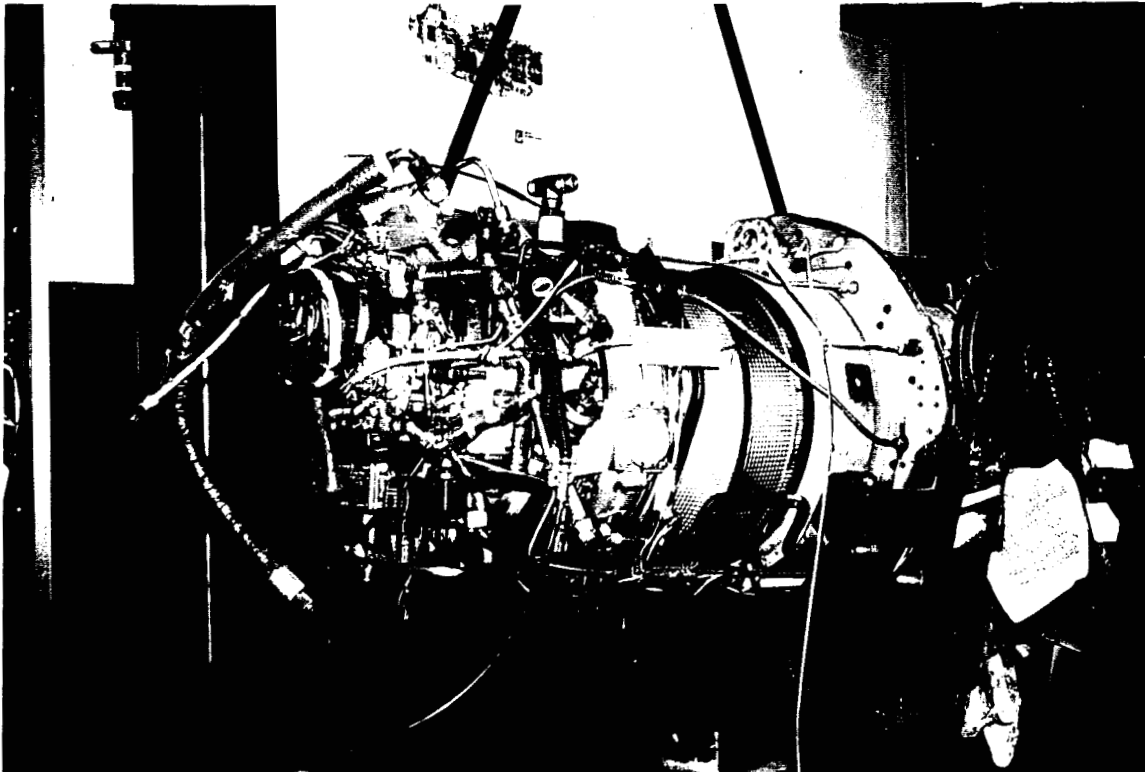


Photo No. 31

Accessory gearbox and aft gas generator case, right hand aft view.

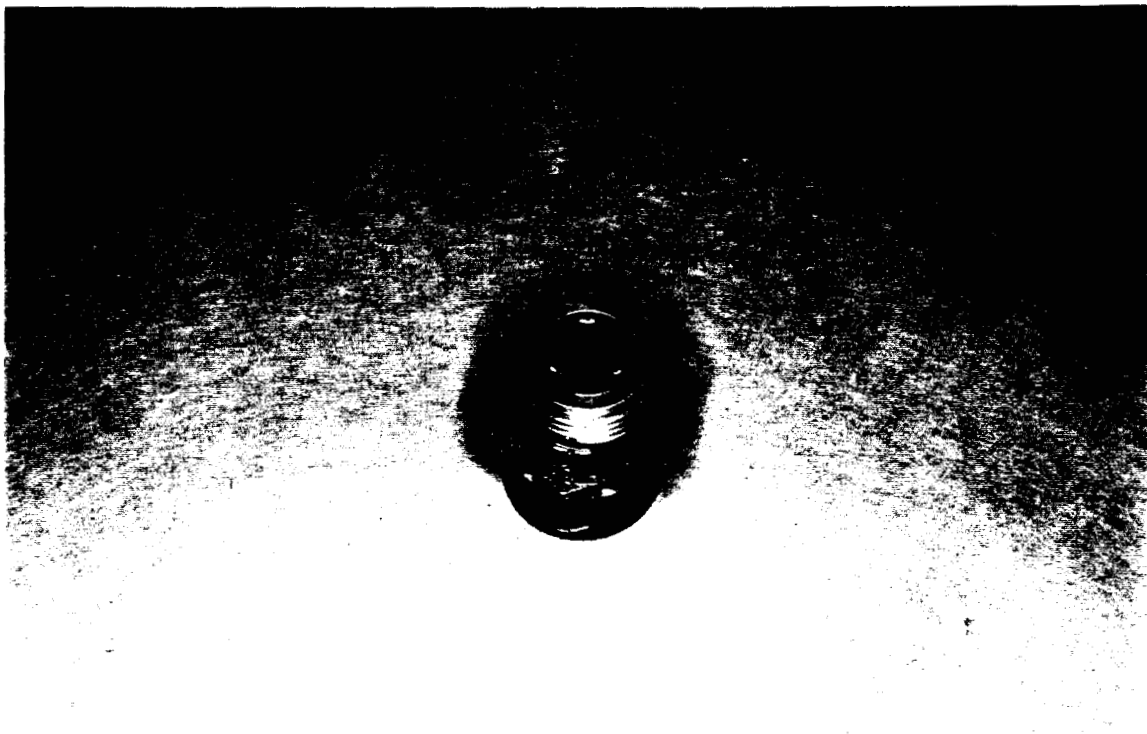


Photo No. 32

Reduction gearbox chip detector.

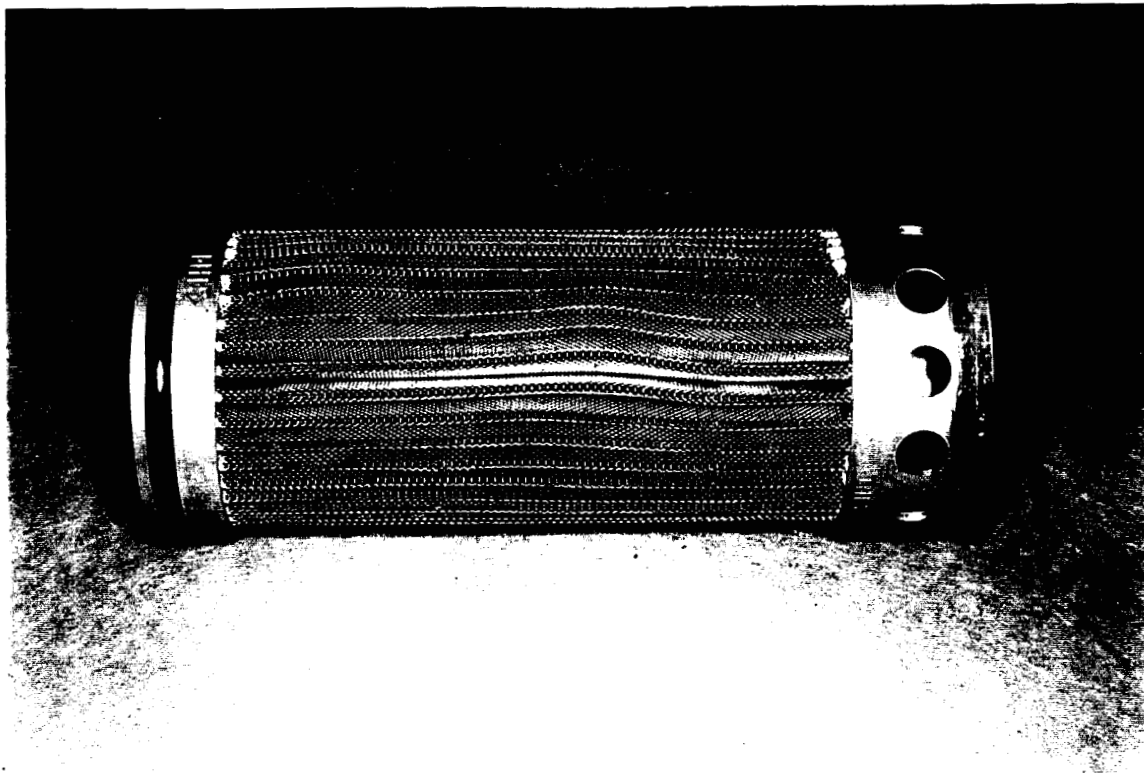


Photo No. 33
Oil filter.

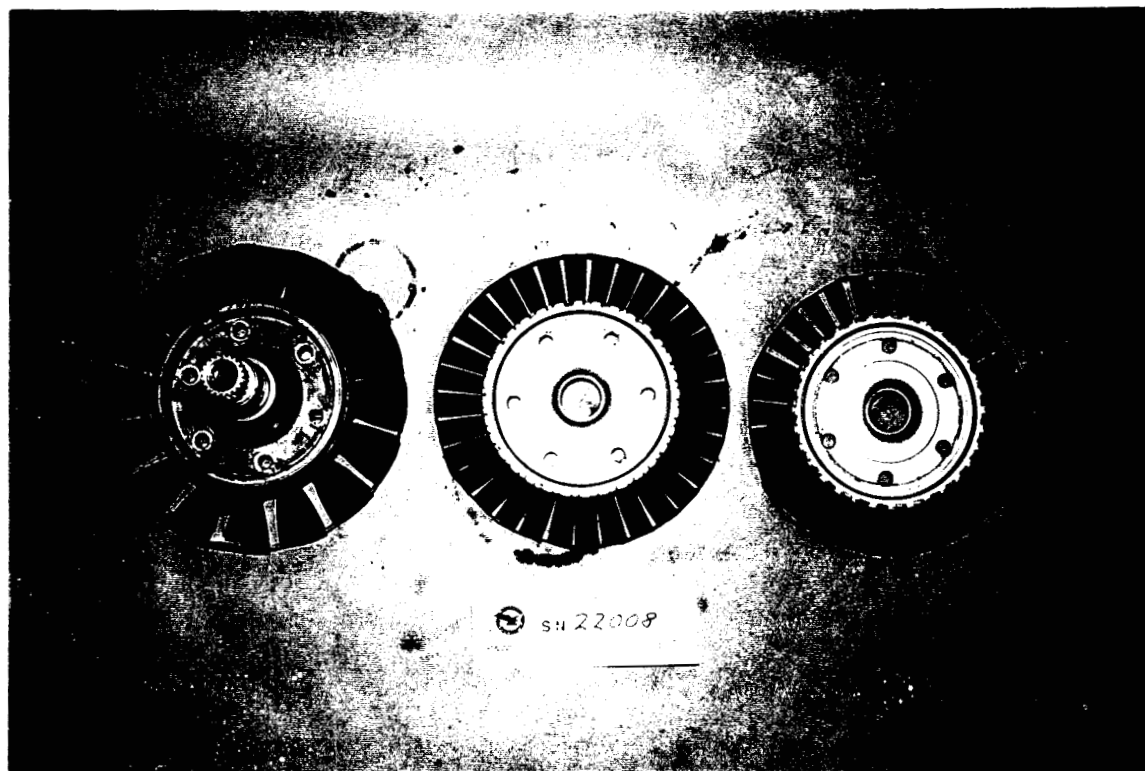


Photo No. 34
Compressor 1st, 2nd, and 3rd stage discs.

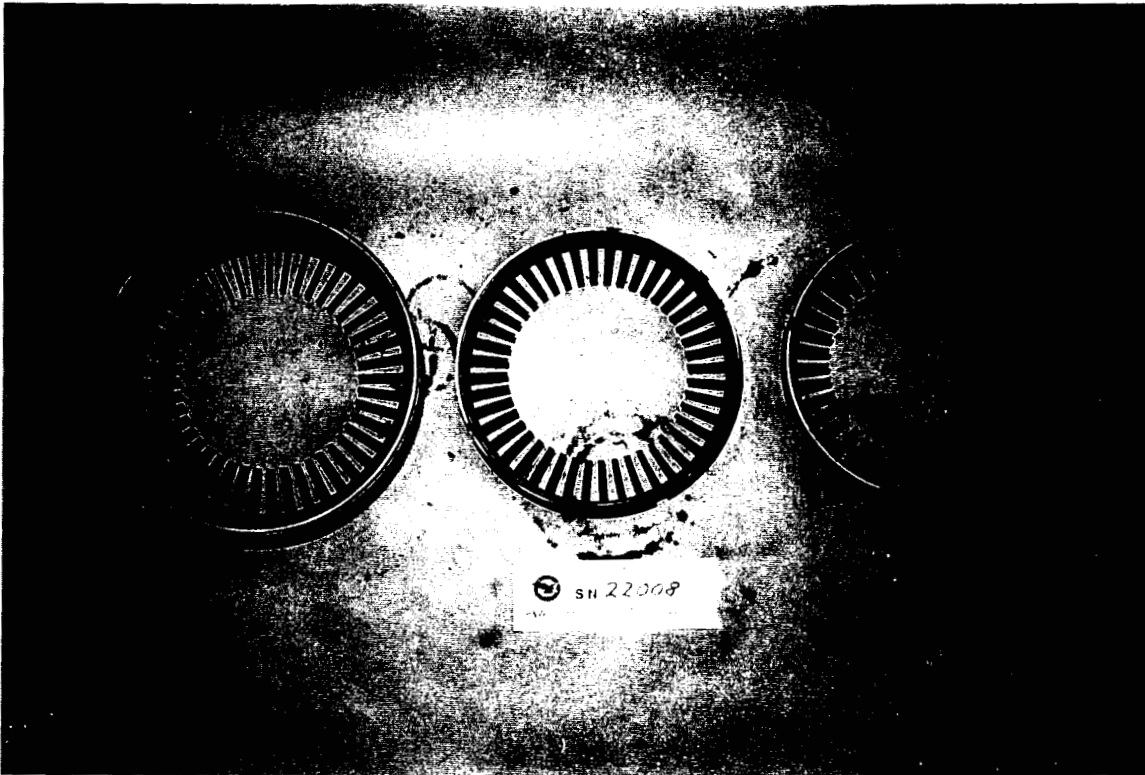


Photo No. 35
Compressor 1st, 2nd, and 3rd stage stators.

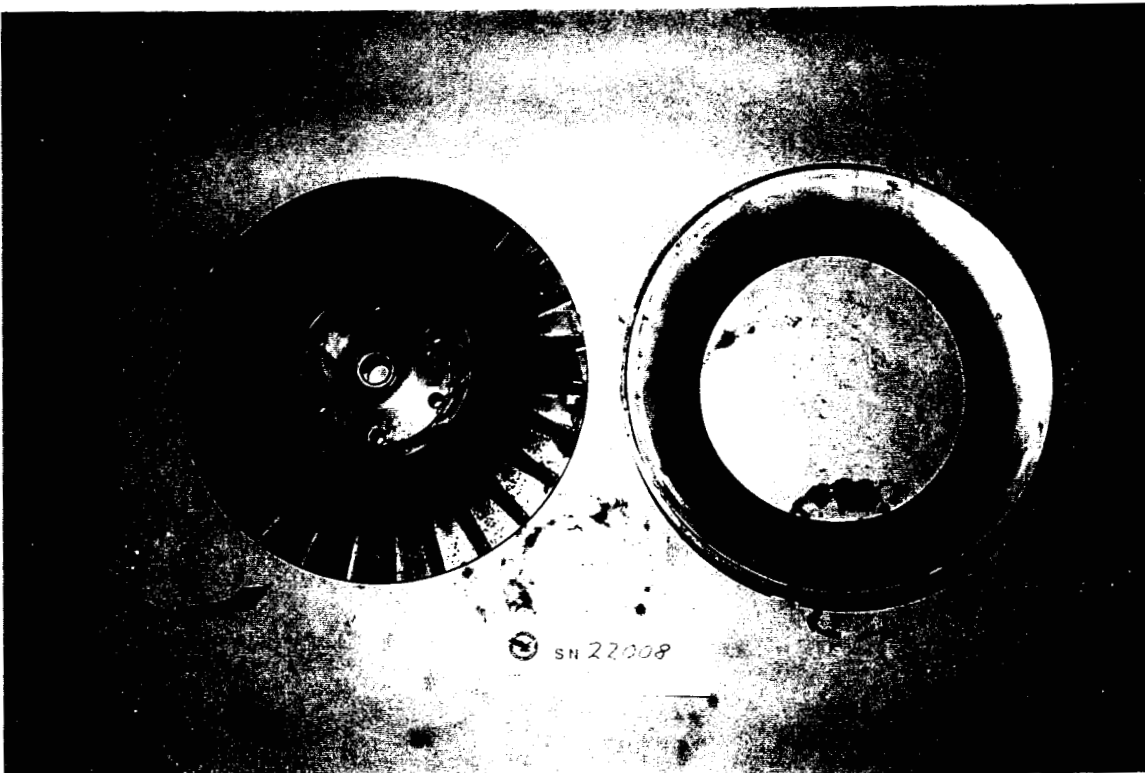


Photo No. 36
Centrifugal impeller and shroud.

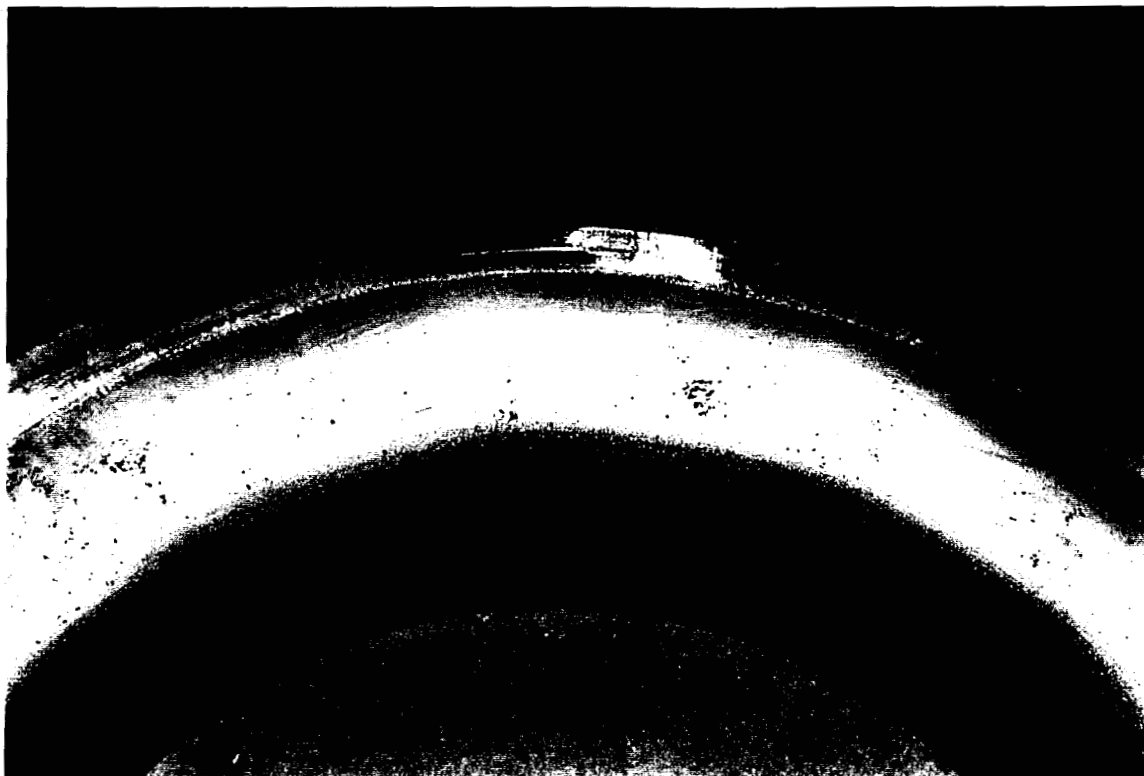


Photo No. 37
Impeller shroud, detail.

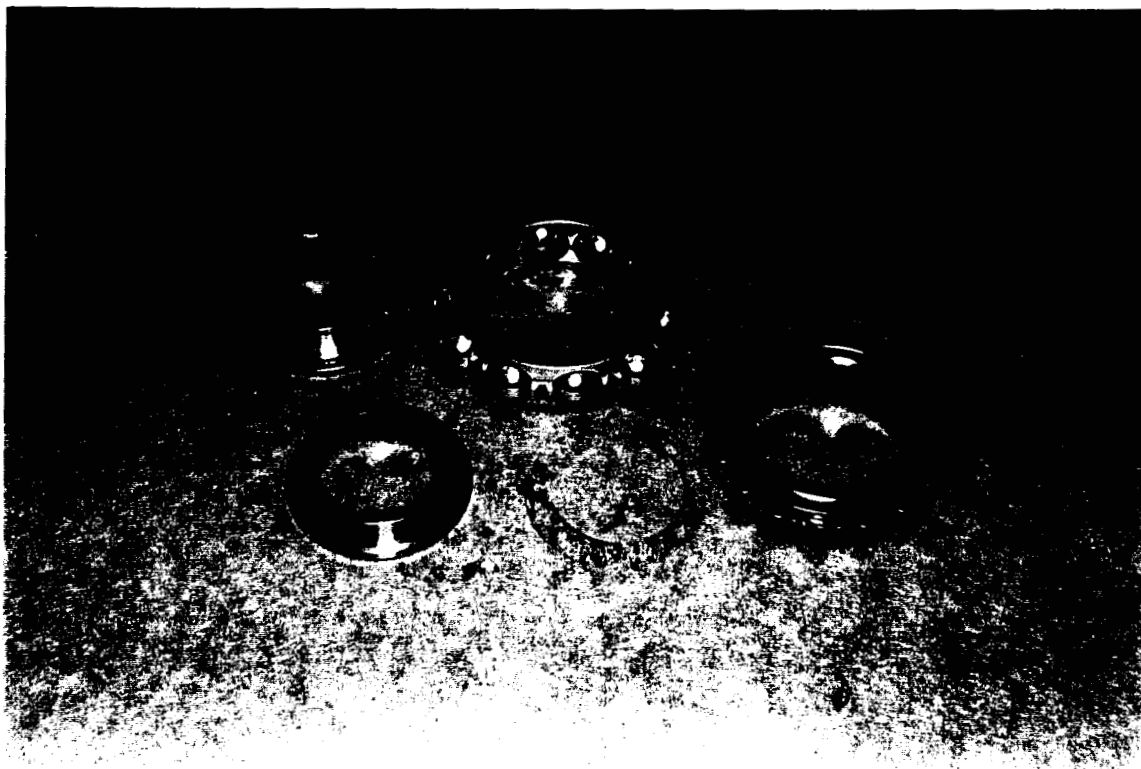


Photo No. 38
Nos. 1 and 2 bearings.



Photo No. 39
Combustion chamber liner.



Photo No. 40
Large exit duct.

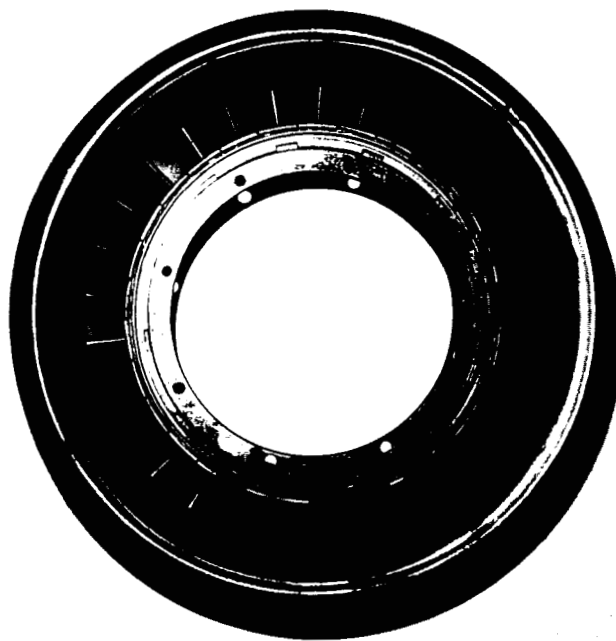


Photo No. 41

Small exit duct and compressor turbine guide vane ring, upstream side.



Photo No. 42

Compressor turbine guide vane ring, downstream side.



Photo No. 43

Compressor turbine guide vane ring and compressor turbine shroud, detail.

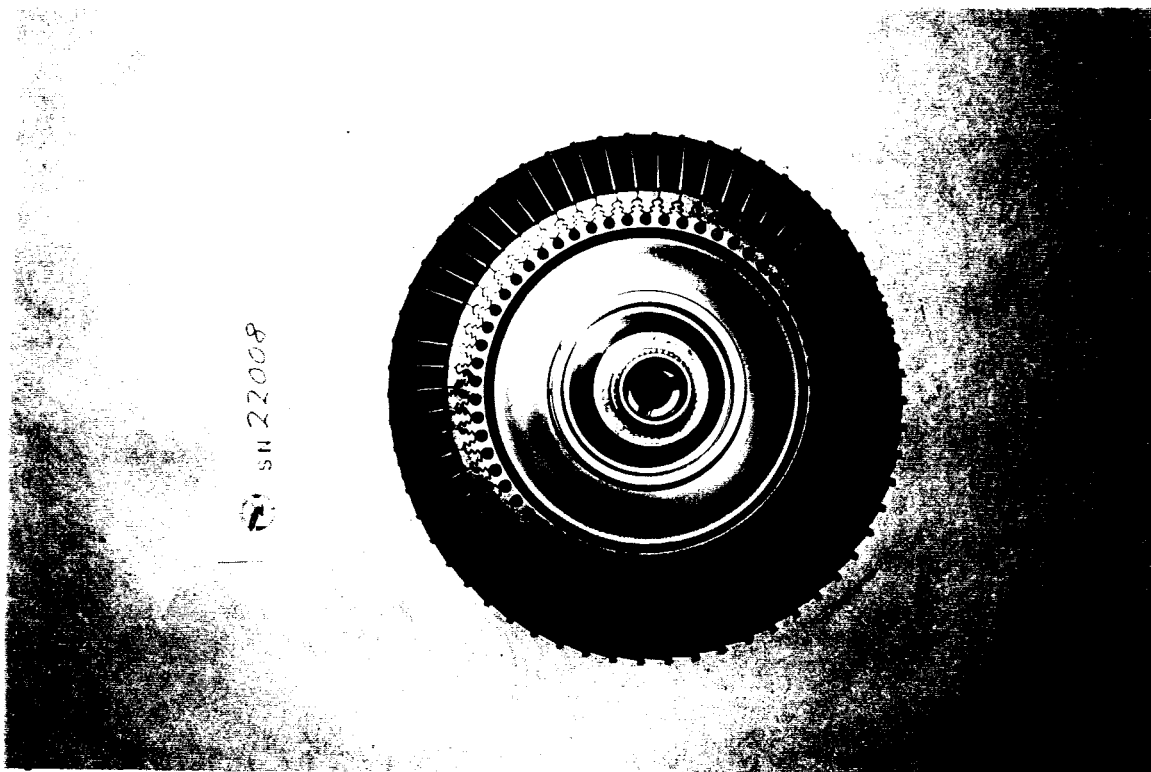


Photo No. 44

Compressor turbine, upstream side.

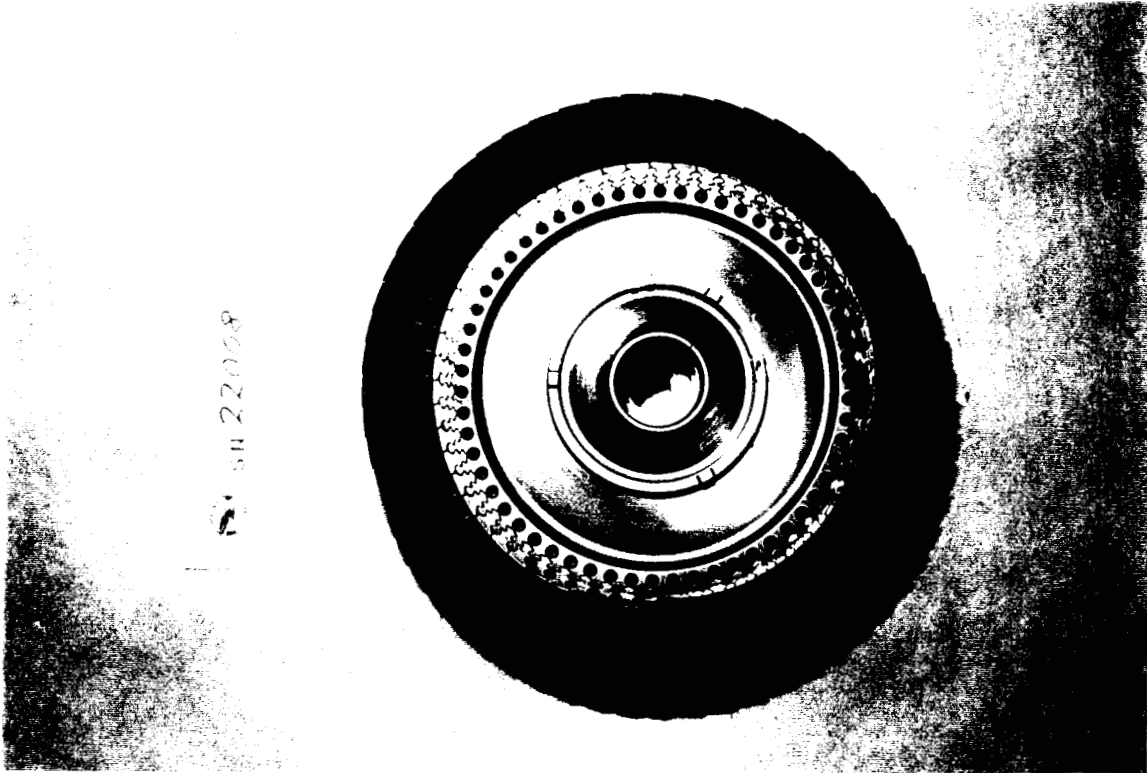


Photo No. 45
Compressor turbine downstream side.

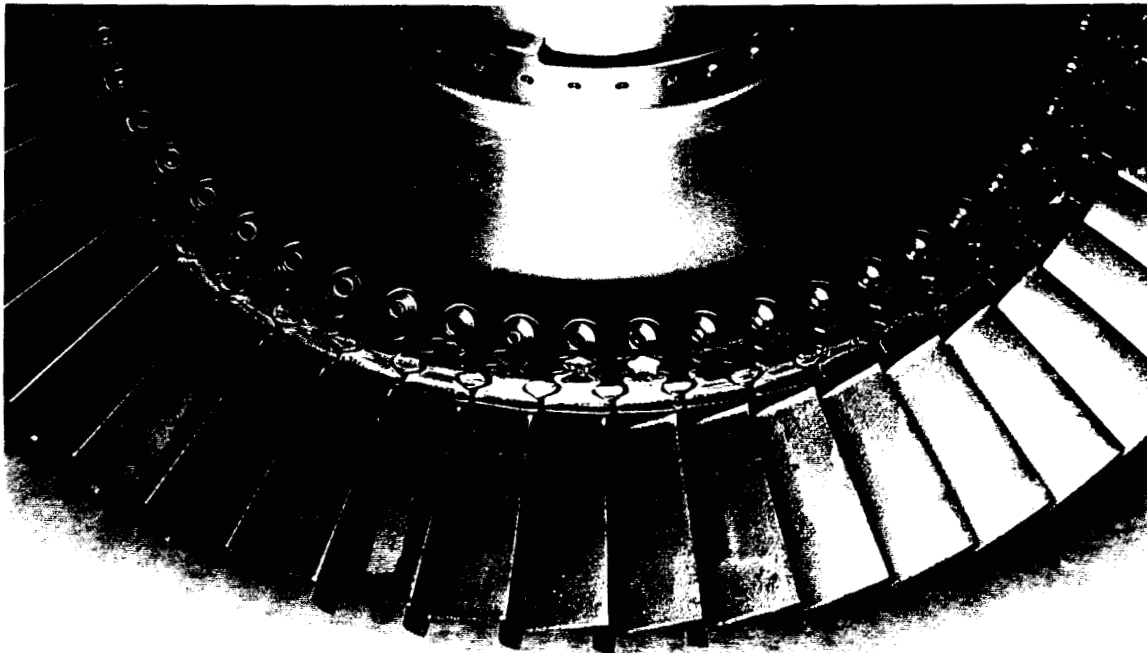


Photo No. 46
Compressor turbine downstream side, detail.

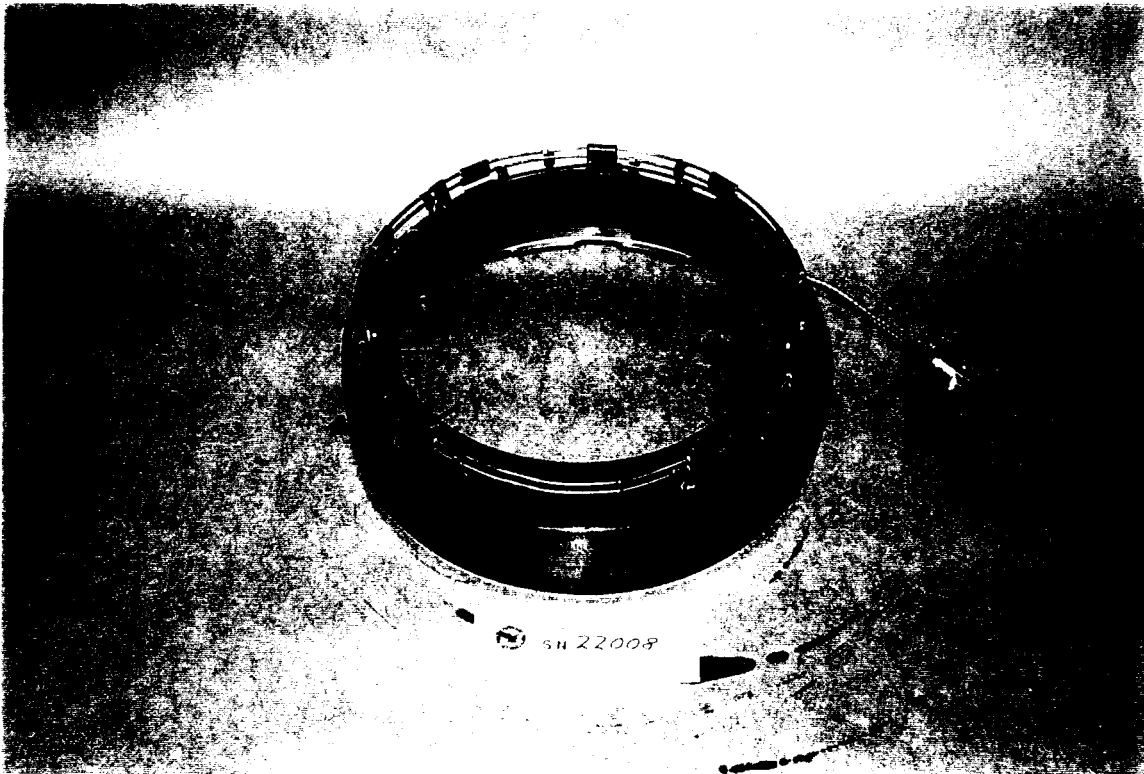


Photo No. 47
Power turbine housing.

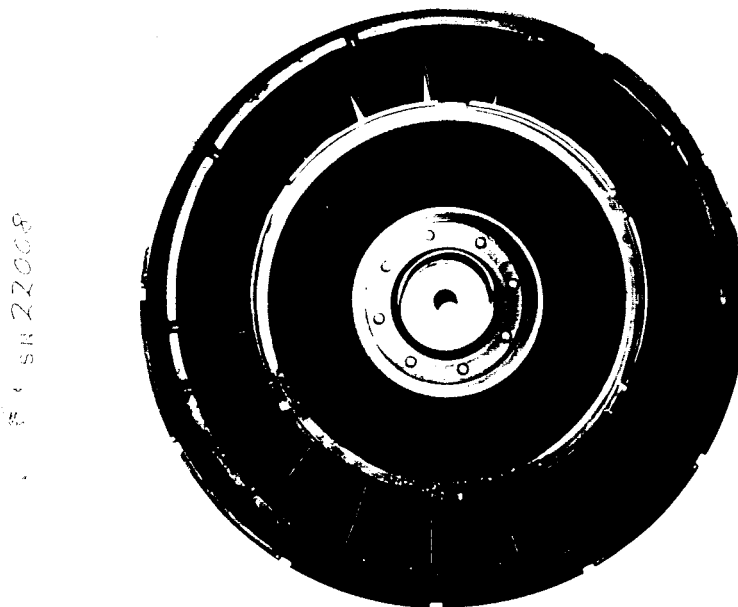


Photo No. 48
Power turbine guide vane ring and interstage baffle, upstream side.

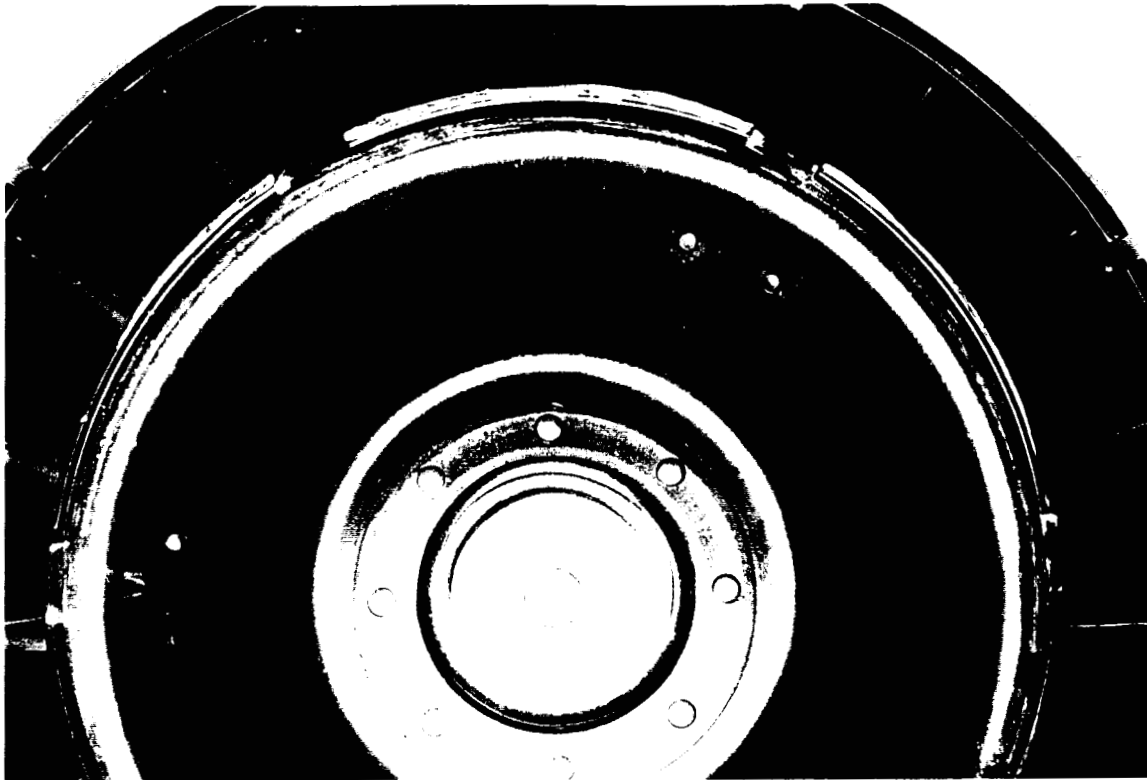


Photo No. 49

Power turbine guide vane ring and interstage baffle upstream side, detail.

SN 22008

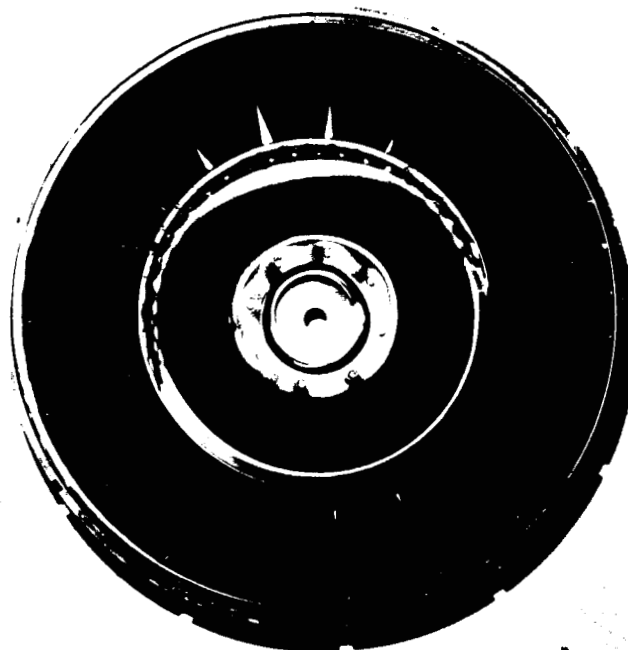


Photo No. 50

Power turbine guide vane ring and interstage baffle, downstream side.

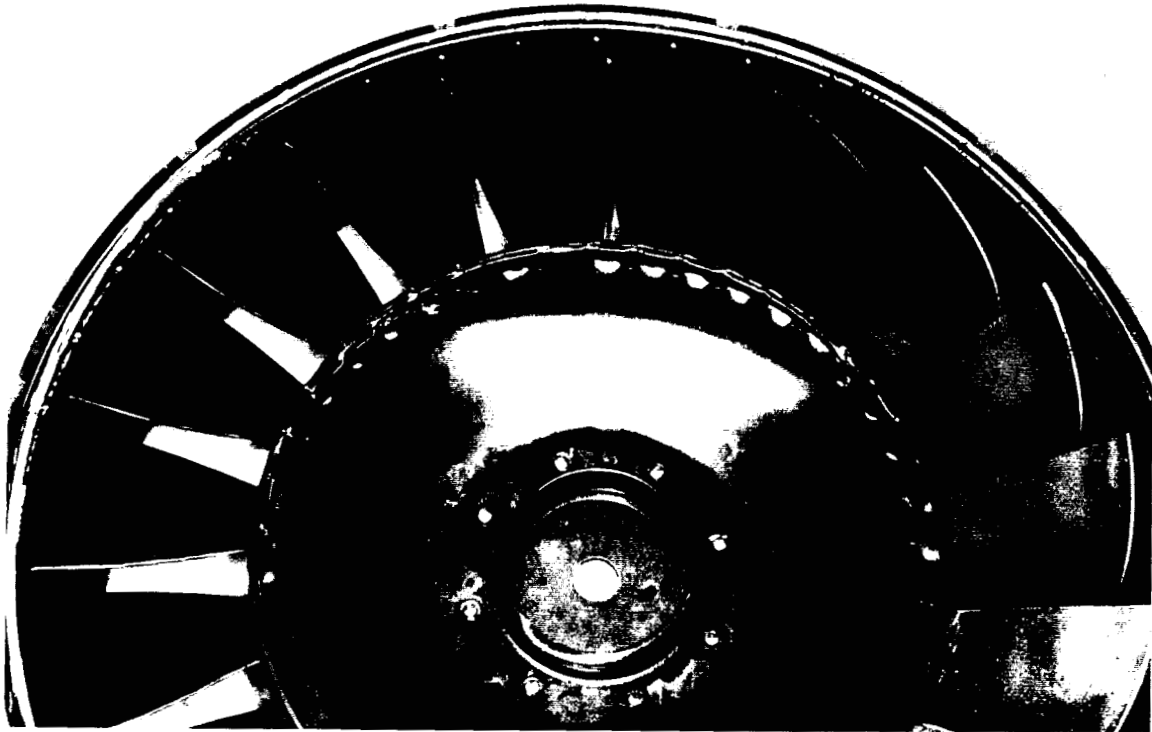


Photo No. 51

Power turbine guide vane ring and interstage baffle downstream side, detail.

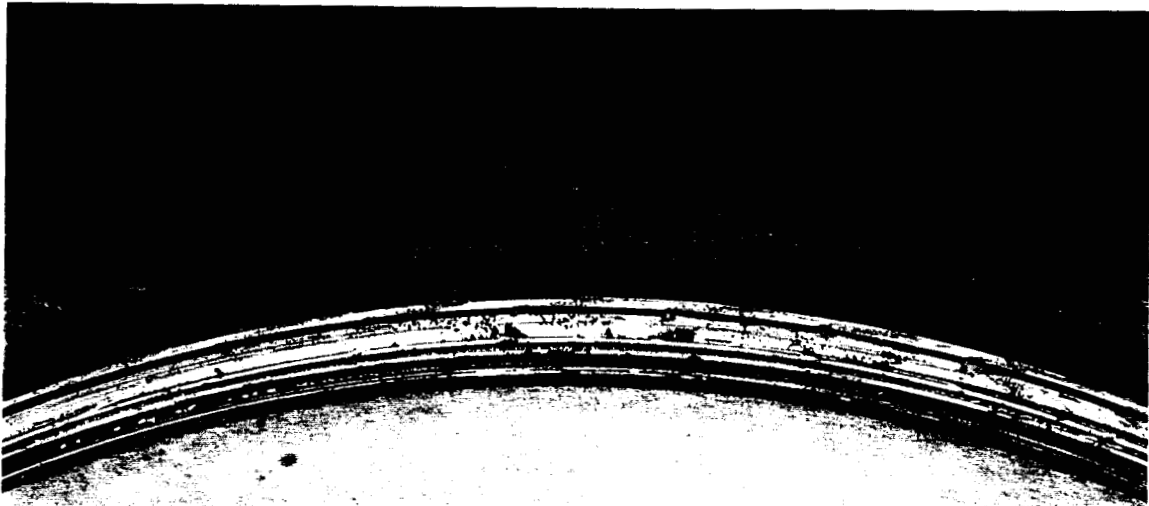


Photo No. 52

Power turbine shroud, detail.

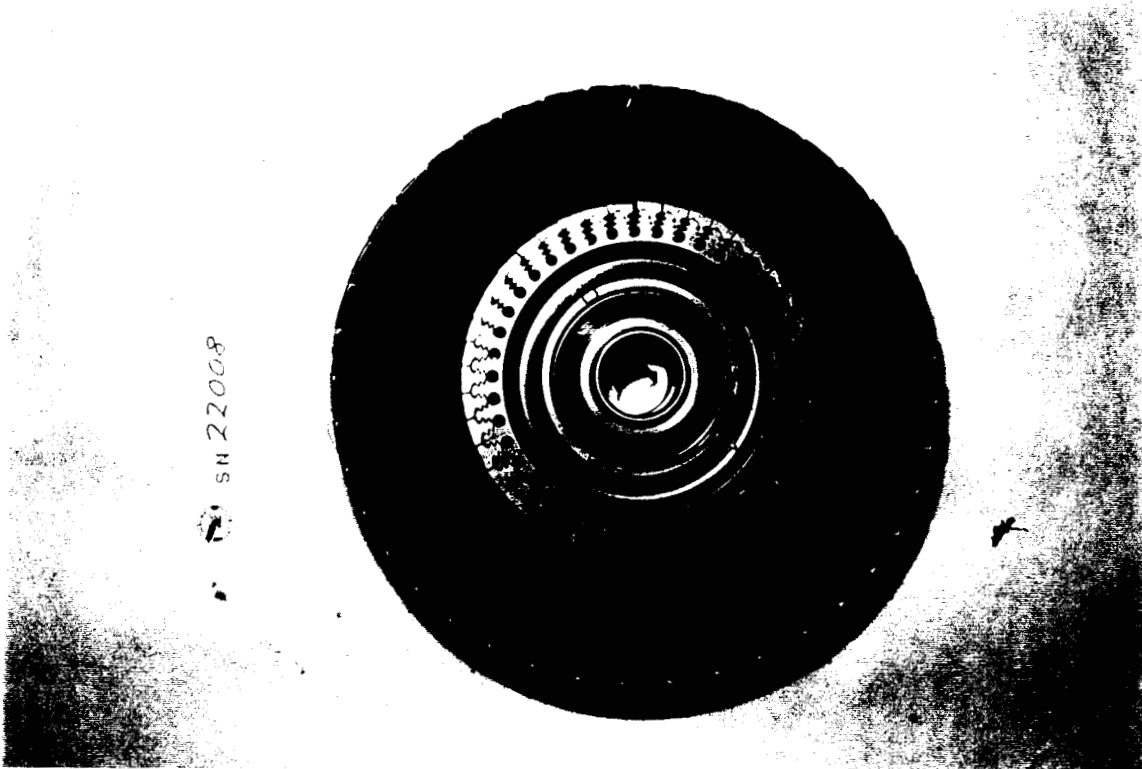


Photo No. 53
Power turbine upstream side.

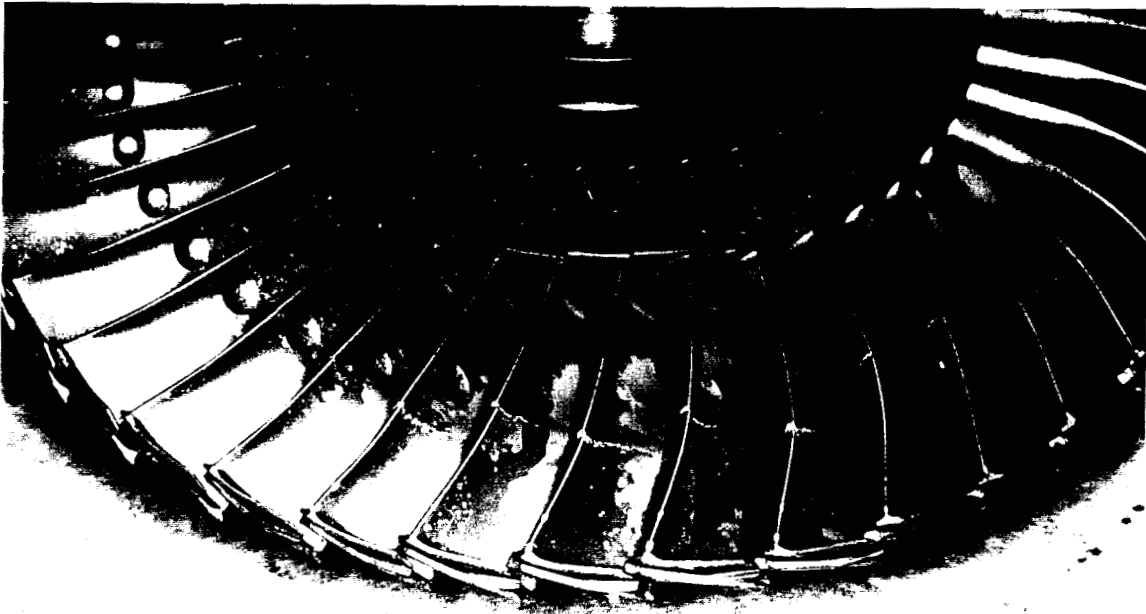


Photo No. 54
Power turbine upstream side, detail.

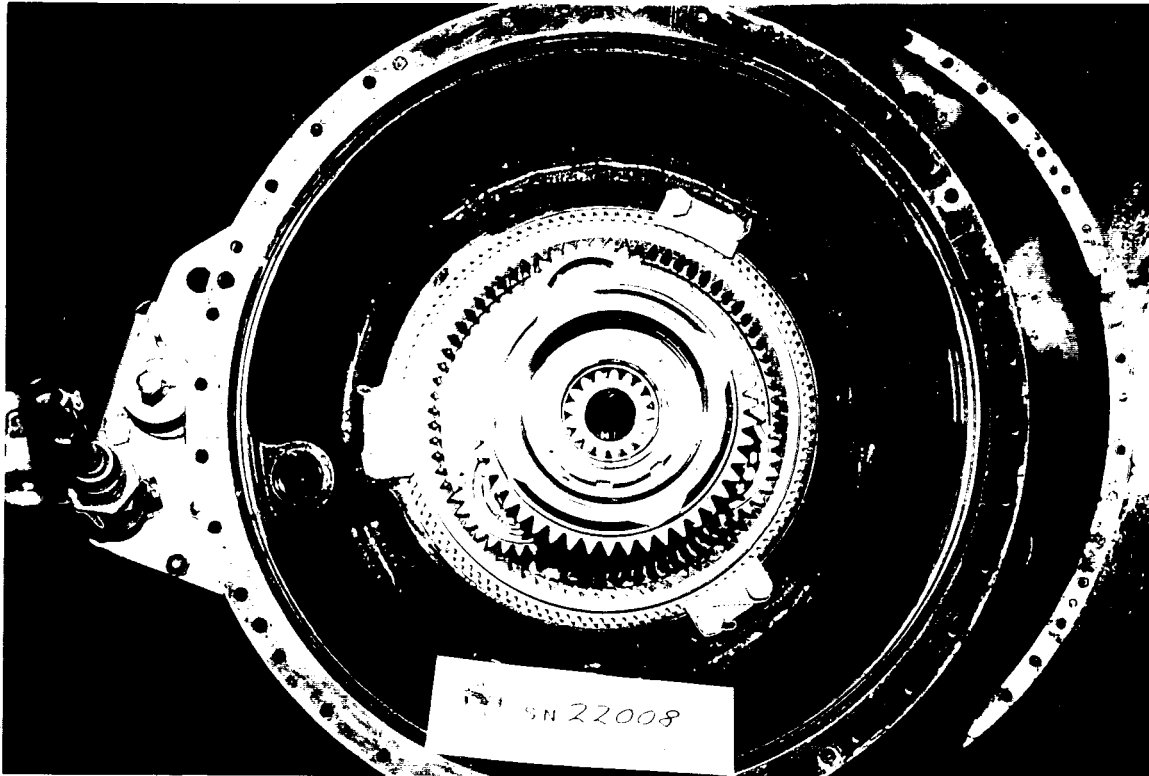


Photo No. 55
Reduction gearbox 1st stage gearing.

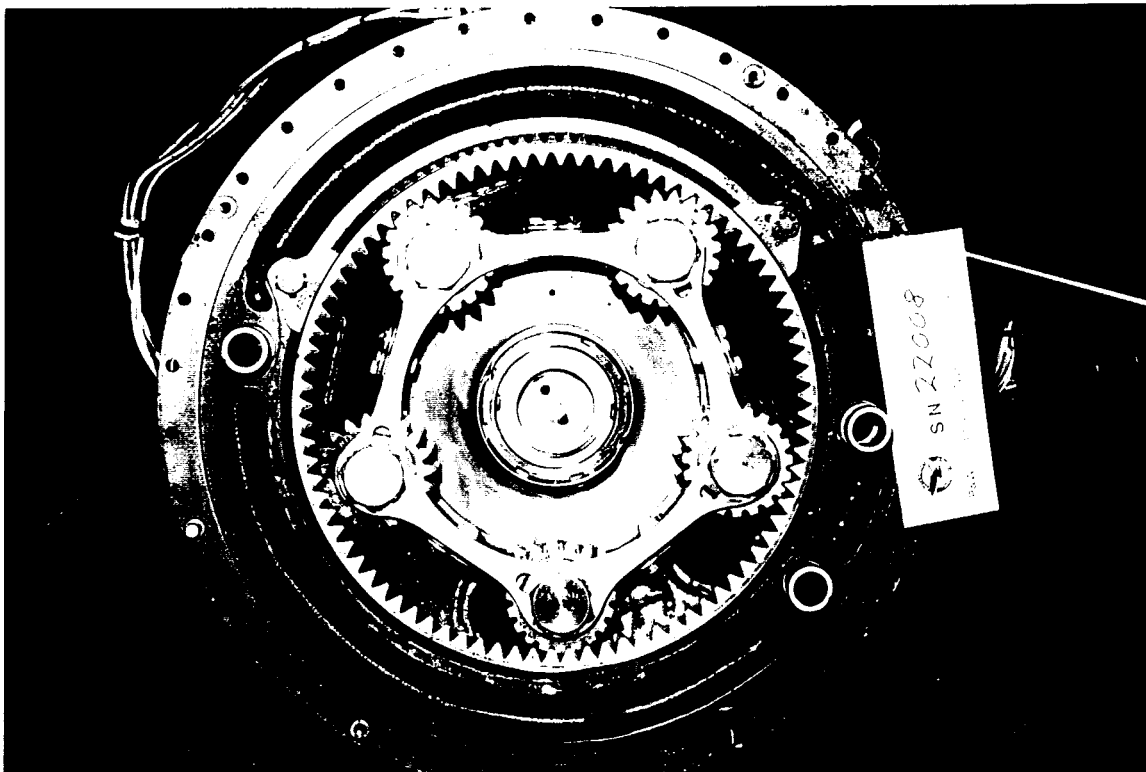


Photo No. 56
Reduction gearbox 2nd stage gearing.